STONEX

Stonex® R5/R6 Series

User Manual

Version 1.0
English

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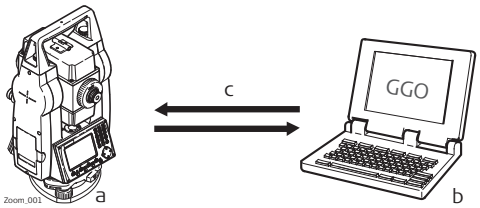
1 Description of the System

1.1 System Components

Main Components

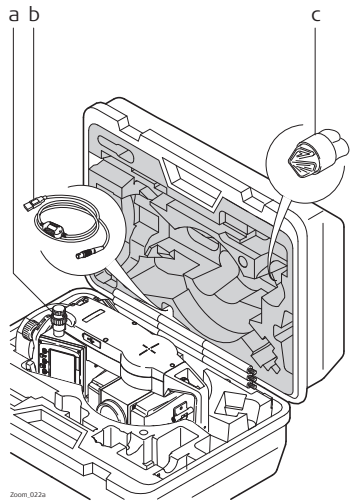


a) R5/R6 instrument
b) Computer with Stonex Software or Stonex Software Tools software
c) Data transfer

Component	Description
R5/R6 instrument	An instrument for measuring, calculating and capturing data. Ideally suited for tasks from simple surveys to complex applications. The various lines have a range of accuracy classes and support different features. All lines can be connected with Stonex Software or Stonex Software Tools to view, exchange and manage data.
Firmware	The firmware package installed on the instrument. Consists of a standard base operating system with optional additional features.
Stonex Software or Stonex Software Tools software	An office software consisting of a suite of standard and extended programs for the viewing, exchanging, managing and post processing of data.
Data transfer	Data can be always transferred between a R5/R6 instrument and a computer via a data transfer cable. For R6 instruments data can also be transferred via USB memory stick or Bluetooth.

1.2 Container Contents

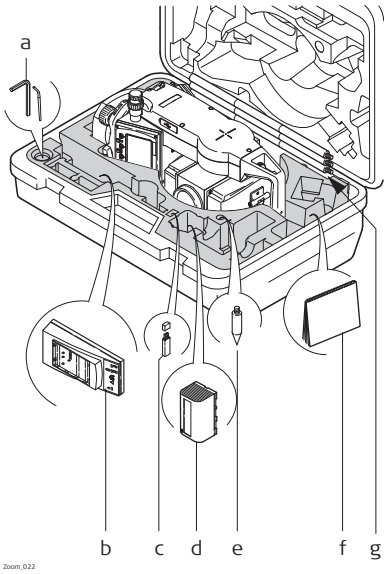
Container contents part 1 of 2



a) Instrument with supplied tribrach
b) ZDC100 data cable (USB-RS232)*
c) Protective cover

* Optional

Container contents part 2 of 2

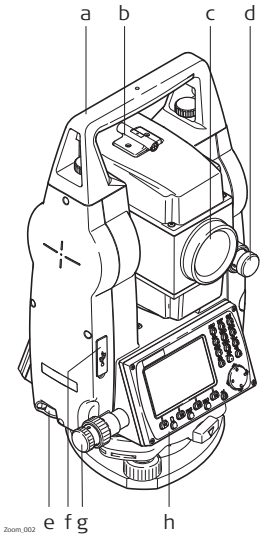


a) Adjustment tools
b) SC11 battery charger*
c) USB memory stick - for R6 instruments*
d) SB21 battery*
e) Tip for mini prism pole*
f) User manual
g) GLS115 mini prism pole*

* Optional

1.3 Instrument Components

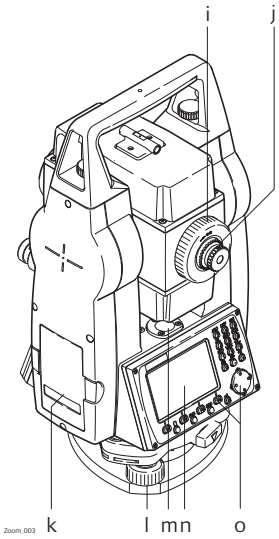
Instrument components part 1 of 2



a) Detachable carrying handle with mounting screw
b) Optical sight
c) Objective with integrated Electronic Distance Measurement (EDM). Exit for EDM laser beam
d) Vertical drive
e) Serial interface RS232/USB
f) USB host port
g) Horizontal drive
h) Second keyboard*

* Optional

Instrument components part 2 of 2

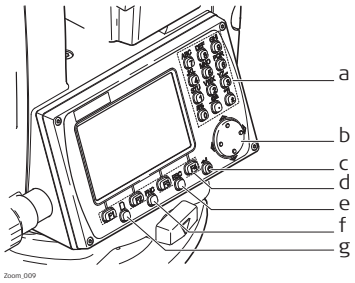


i) Focusing telescope image
j) Eyepiece; focusing graticule
k) Battery cover
l) Foot screw
m) Circular level
n) Display
o) Keyboard

2 User Interface

2.1 Keyboard

Alphanumeric keyboard



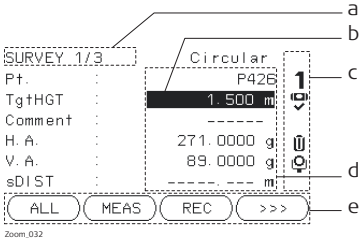
a) Alphanumeric keypad
b) Navigation key
c) **ENTER** key
d) Function keys **F1** to **F4**
e) **ESC** key
f) **FNC** key
g) **PAGE** key

Keys

Key	Description
	Page key. Displays the next screen when several screens are available.
	FNC key. Quick-access to measurement supporting functions.
	Navigation key. Controls the focus bar within the screen and the entry bar within a field.
	ENTER key. Confirms an entry and continues to the next field.
	ESC key. Quits a screen or edit mode without saving changes. Returns to next higher level.
	Function keys that are assigned the variable functions displayed at the bottom of the screen.
	Alphanumeric keypad for entry of text and numerical values.

2.2 Screen

Screen



a) Title of screen
b) Focus in screen. Active field
c) Status icons
d) Fields
e) Softkeys

☞ All shown screens are examples. It is possible that local firmware versions are different to the basic version.

2.3 Status Icons

Description
The icons provide status information related to basic instrument functions. Depending on the firmware version, different icons are displayed.

Icons

Icon	Description
	The battery symbol indicates the level of the remaining battery capacity, 75% full shown in the example.
	Compensator is on.
	Compensator is off.
	IR EDM mode for measuring to prisms and reflective targets.
	RL EDM mode for measuring to all targets.
!	Offset is active.
NUM	Keypad is set to numeric mode.
a	Keypad is set to alphanumeric mode.
	Indicates that horizontal angle is set to left side angle measurement (anticlockwise).
	A double arrow indicates a field has a selectable list.
	Up and down arrows indicate that several screens are available, which are accessed using .
1	Indicates telescope position is face I.
2	Indicates telescope position is face II.
	Bluetooth is connected. If there is a cross beside the icon, the Bluetooth communication port is selected, but the status is inactive.
	USB communication port is selected.

2.4 Softkeys

Description

Softkeys are selected using the relevant **F1** to **F4** function key. This chapter describes the functionality of the common softkeys used by the system. The more specialised softkeys are described where they appear in the application chapters.

Common softkey functions

Key	Description
ALPHA	To change the keypad operation to alphanumerical.
NUM	To change the keypad operation to numerical.
ALL	To start distance and angle measurements and save the measured values.
BACK	To return to the last active screen.
COORD	To open the manual coordinate entry screen.
EDM	To view and change EDM settings. Refer to "4.2 EDM Settings".
EXIT	To exit the screen or application.
MEAS	To start distance and angle measurements without saving the measured values.
OK	If entry screen: Confirms measured or entered values and continues the process. If message screen: Confirms message and continues with selected action or returns to the previous screen to reselect an option.
IR/RL	To toggle between IR and RL EDM modes.
DISPL.	To display the list of available points.
REC	To save the displayed values.
DEFLT	To reset all editable fields to their default values.
SEARCH	To search for an entered point.
VIEW	To display the coordinate and job details of the selected point.
>>>	To display the next softkey level.

2.5 Operating Principles

Turn instrument on/off

Use the On/Off key.

Alphanumeric keypad

The alphanumerical keypad is used to enter characters directly into editable fields.

- **Numeric fields**: Can only contain numerical values. By pressing a key of the keypad the number will be displayed.
- **Alphanumeric fields**: Can contain numbers and letters. By pressing a key of the keypad the first character written above that key will be displayed. By pressing several times you can toggle through the characters. For example: 1->S->T->U->1->S....

Edit fields

☞ **ESC** Deletes any change and restores the previous value.

◂ Moves the cursor to the left

▸ Moves the cursor to the right.

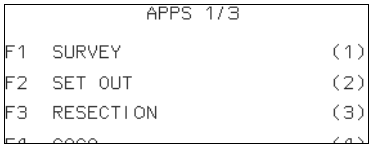
▴ Inserts a character at the cursor position.

▾ Deletes the character at the cursor position.

☞ In edit mode the position of the decimal place cannot be changed. The decimal place is skipped.

Special characters

Character	Description
*	Used as wildcards in search fields for point numbers or codes. Refer to "2.6 Pointsearch".
+/-	In the alphanumeric character set "+" and "-" are treated as normal alphanumeric characters with no mathematical function. ☞ "+" / "-" only appear in front of an entry.



In this example selecting 2 on an alphanumeric keyboard would start the Set Out application.

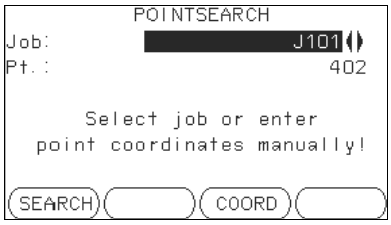
2.6 Pointsearch

Description

Pointsearch is a function used by applications to find measured or fixed points in the memory storage.
It is possible to limit the point search to a particular job or to search the whole storage. The search procedure always finds fixed points before measured points that fulfill the same search criteria. If several points meet the search criteria, then the results are ordered according to the entry date. The instrument finds the most recent fixed point first.

Direct search

By entering an actual point number, for example 402, and pressing **SEARCH**, all points within the selected job and with the corresponding point number are found.



SEARCH
To search for matching points within the selected job.

Wildcard search

The wildcard search is indicated by a "*". The asterisk is a place holder for any following sequence of characters. Wildcards should be used if the point number is not fully known, or to search for a batch of points.

Examples of point searches

* All points are found.
A All points with exactly the point number "A" are found.
A* All points starting with "A" are found, for example, A9, A15, ABCD, A2A.
*1 All points containing only one "1" are found, for example, 1, A1, AB1.
A*1 All points starting with "A" and containing only one "1" are found, for example, A1, AB1, A51.

3 Operation

3.1 Instrument Setup

Description

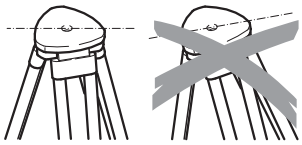
This topic describes an instrument setup over a marked ground point using the laser plummet. It is always possible to set up the instrument without the need for a marked ground point.

☞

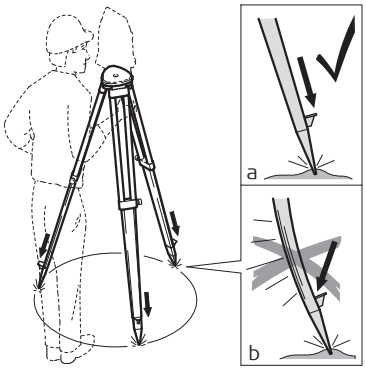
Important features

- It is always recommended to shield the instrument from direct sunlight and avoid uneven temperatures around the instrument.
- The laser plummet described in this topic is built into the vertical axis of the instrument. It projects a red spot onto the ground, making it appreciably easier to centre the instrument.
- The laser plummet cannot be used with a tribrach equipped with an optical plummet.

Tripod

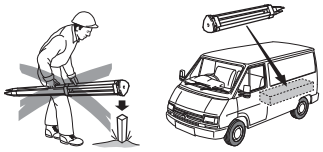


☞ When setting up the tripod pay attention to ensuring a horizontal position of the tripod plate. Slight corrections of inclination can be made with the foot screws of the tribrach. Larger corrections must be done with the tripod legs.



Loosen the clamping screws on the tripod legs, pull out to the required length and tighten the clamps.

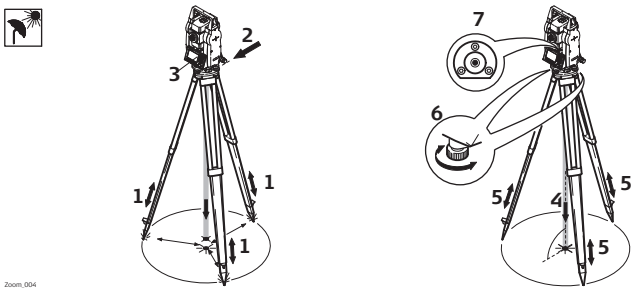
a) In order to guarantee a firm foothold sufficiently press the tripod legs into the ground.
b) When pressing the legs into the ground note that the force must be applied along the legs.



Careful handling of tripod.

- Check all screws and bolts for correct fit.
- During transport always use the cover supplied.
- Use the tripod only for surveying tasks.

Setup step-by-step



1 Extend the tripod legs to allow for a comfortable working posture. Position the tripod over the marked ground point, centring it as best as possible.
2 Fasten the tribrach and instrument onto the tripod.
3 Turn on the instrument, and, if tilt correction is set to 1- or 2-axis, the laser plummet will be activated automatically, and the **Level & Plummet** screen appears. Otherwise, press **FNC** from within any application and select **Level & Plummet**.
4 Move the tripod legs (1) and use the tribrach footscrews (6) to center the plummet (4) over the ground point.
5 Adjust the tripod legs (5) to level the circular level (7).
6 By using the electronic level, turn the tribrach footscrews (6) to precisely level the instrument. Refer to "Level up with the electronic level step-by-step".
7 Center the instrument precisely over the ground point by shifting the tribrach on the tripod plate (2).
8 Repeat steps 6 and 7 until the required accuracy is achieved.

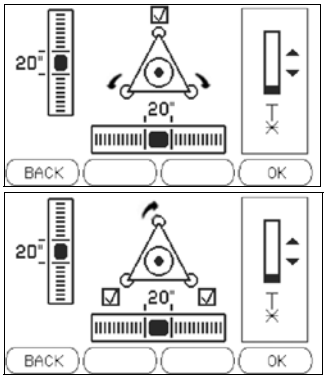
Level up with the electronic level step-by-step

The electronic level can be used to precisely level up the instrument using the footscrews of the tribrach.

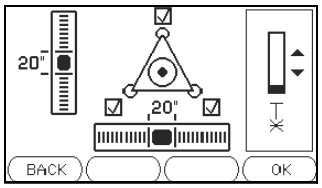
1) Turn the instrument until it is parallel to two footscrews.
2) Center the circular level approximately by turning the footscrews of the tribrach.
3) Turn on the instrument, and, if tilt correction is set to 1- or 2-axis, the laser plummet will be activated automatically, and the **Level & Plummet** screen appears. Otherwise, press **FNC** from within any application and select **Level & Plummet**.

☞ The bubble of the electronic level and the arrows for the rotating direction of the footscrews only appear if the instrument tilt is inside a certain levelling range.

4 Center the electronic level of the first axis by turning the two footscrews. Arrows show the direction of rotation required. When the electronic level is centered the arrows are replaced by checkmarks.
5 Center the electronic level for the second axis by turning the last footscrew. An arrow shows the direction of rotation required. When the electronic level is centered the arrow is replaced by a checkmark.



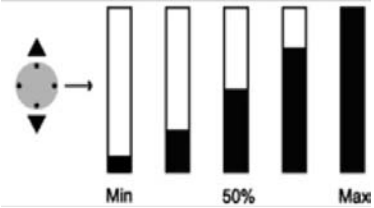
When the electronic level is centered and three checkmarks are shown, the instrument has been perfectly levelled up.



6 Accept with **OK**.

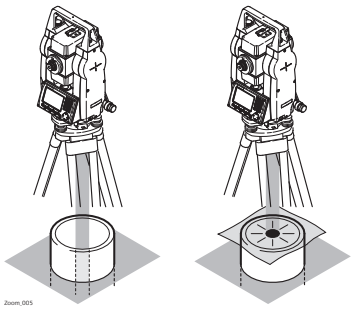
Change the intensity of the laser plummet

External influences and the surface conditions may require the adjustment of the intensity of the laser plummet.



In the **Level & Plummet** screen, adjust the intensity of the laser plummet using the navigation key.
The laser can be adjusted in 25% steps as required.

Position over pipes or holes



Under some circumstances the laser dot is not visible, for example over pipes. In this case, using a transparent plate enables the laser dot to be seen and then easily aligned to the center of the pipe.

3.2 Working with the Battery

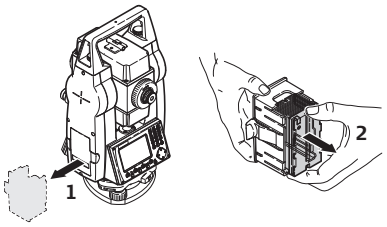
Charging / first-time use

- The battery must be charged prior to using it for the first time because it is delivered with an energy content as low as possible.
- For new batteries or batteries that have been stored for a long time (> three months), it is effectual to make only one charge/discharge cycle.
- The permissible temperature range for charging is between 0°C to +40°C/+32°F to +104°F. For optimal charging we recommend charging the batteries at a low ambient temperature of +10°C to +20°C/+50°F to +68°F if possible.
- It is normal for the battery to become warm during charging. Using the chargers recommended by Stonex®, it is not possible to charge the battery if the temperature is too high.

Operation / discharging

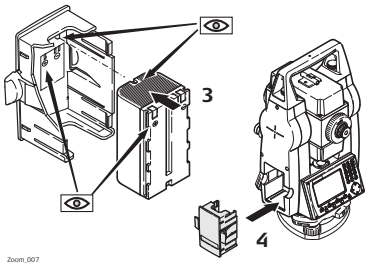
- The batteries can be operated from -20°C to +50°C/-4°F to +122°F.
- Low operating temperatures reduce the capacity that can be drawn; very high operating temperatures reduce the service life of the battery.
- For Li-Ion batteries, a single discharging and charging cycle is sufficient. We recommend carrying out the process when the battery capacity indicated on the charger or on a Stonex® product deviates significantly form the actual battery capacity available.

Change the battery step-by-step



Open the battery compartment (1) and remove the battery holder.

Remove the battery from the battery holder (2).



Insert the new battery into the battery holder (3), ensuring that the contacts are facing outward. The battery should click into position.

Insert the battery holder back into the battery compartment (4).

☞ The polarity of the battery is displayed inside the battery housing.

⚠ **Warning**

If charged or discharged, batteries not recommended by Stonex® may be damaged. They may burn and explode.

Precautions:

Only charge and discharge batteries recommended by Stonex®.

3.3 Data Storage

Description

An internal memory is included in all instruments. The firmware stores all data in jobs in a database in the internal memory. Data can then be transferred to a computer or other device for post processing via a cable connected to the serial interface RS232 port.
For R6 instruments, data can also be transferred from the internal memory to a computer or other device via:

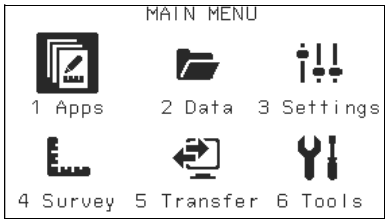
- a USB memory stick inserted into the USB host port, or
- via a Bluetooth connection.

Refer to "10 Data Management" for further information on data management and data transfer.

3.4 Main Menu

Description
The **MAIN MENU** is the starting place for accessing all functionality of the instrument. It is usually displayed immediately after the **Level & Plummet** screen, after switching on the instrument.

MAIN MENU



Description of the MAIN MENU functions

Function	Description
Apps	To select and start applications. Refer to "9 Applications".
Data	To manage jobs, data, codelists, formats, system memory and USB memory stick files. Refer to "10 Data Management".
Settings	To change EDM configurations, comm.-setup and general instrument settings. Refer to "4 Settings".
Survey	**Survey** program to begin measuring immediately. Refer to "3.5 Survey Application".
Transfer	To export and import data. Refer to "10.2 Exporting Data".
Tools	To access instrument related tools such as calibrations, personal start up settings, licence keys and system information. Refer to "5 Tools".

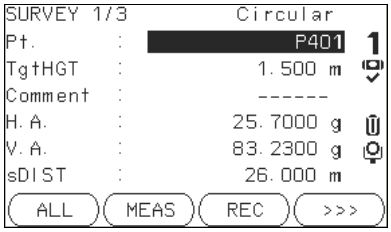
☞
If desired, the instrument can be configured to start in a user defined place after the **Level & Plummet** screen, instead of the **MAIN MENU**. Refer to "5.2 Auto Start Routine".

3.5 Survey Application

Description
After switching on and setting up correctly, the instrument is immediately ready for measuring.

Access
Select **Survey** from the **MAIN MENU**.

SURVEY



>>> **CODING**
To find/enter codes. Refer to "7 Coding".
>>> **STN**
To enter station data and set the station.
>>> **Set HA**
To set the horizontal direction orientation.
>>> **HA ← / HA →**
To set the horizontal angle reading to the left (anti-clockwise) or to the right (clockwise).

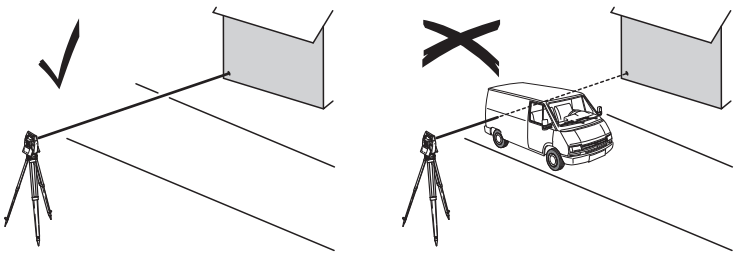
The procedure for the quick start **Survey** is identical to the procedure for the application **Survey** available under the **Apps** menu. Therefore this procedure is only described once within the application chapter. Refer to "9.2 Survey".

3.6 Distance Measurements - Guidelines for Correct Results

Description
A laser distancer (EDM) is incorporated into the R5/R6 instruments. In all versions, the distance can be determined by using a visible red laser beam which emerges coaxially from the telescope objective. There are two EDM modes:

- Prism measurements (IR)
- Reflectorless measurements (RL)

RL measurements



- When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment. If a temporary obstruction, for example a passing vehicle,

heavy rain, fog or snow is between the instrument and the point to be measured, the EDM may measure to the obstruction.
- Be sure that the laser beam is not reflected by anything close to the line of sight, for example highly reflective objects.
- Avoid interrupting the measuring beam while taking reflectorless measurements or measurements using reflective foils.
- Do not measure with two instruments to the same target simultaneously.

IR measurements
- Accurate measurements to prisms should be made in IR-Default mode.
- Measurements to strongly reflecting targets such as traffic lights in Prism mode without a prism should be avoided. The measured distances may be wrong or inaccurate.
- When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment. If for example people, cars, animals, or swaying branches cross the laser beam while a measurement is being taken, a fraction of the laser beam is reflected from these objects and may lead to incorrect distance values.
- Measurements to prisms are only critical if an object crosses the measuring beam at a distance of 0 to 30 m and the distance to be measured is more than 300 m.
- In practice, because the measuring time is very short, the user can always find a way of avoiding unwanted objects from interferring in the beam path.

Red laser to prism
- RL-Long Range mode enables distance measurements of over 3.5 km to standard prisms using the visible red laser beam.

Red laser to reflector foil
- The visible red laser beam can also be used to measure to reflective foils. To guarantee the accuracy the red laser beam must be perpendicular to the reflector foil and it must be well adjusted.
- Make sure the additive constant belongs to the selected target (reflector).

Warning

Due to laser safety regulations and measuring accuracy, using the Long Range Reflectorless EDM is only allowed to prisms that are more than 1000 m (3300 ft) away.

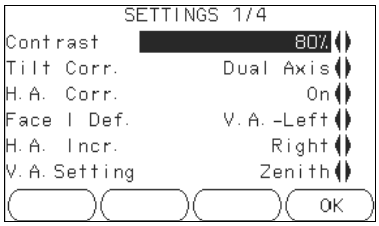
4 Settings

4.1 General Settings

Access

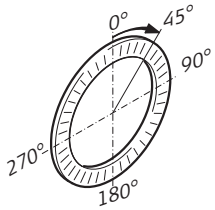
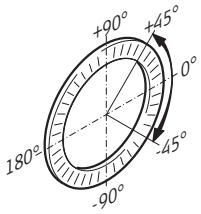
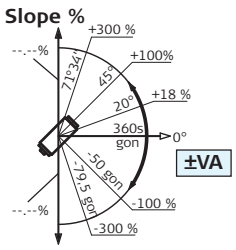
1) Select **Settings** from the **MAIN MENU**.
2) Select **General** from the **SETTINGS** menu.
3) Press ⍥ to scroll through the screens of available settings.

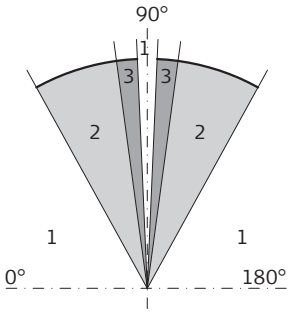
SETTINGS



DelLng
To delete a selected language.

Field	Description	
Contrast	**0**% to **100%**	Sets the display contrast in 10% steps.
Tilt Corr.	**Off**	Tilting compensation deactivated.
	Single Axis	Vertical angles refer to the plummet line.
	Dual Axis	Vertical angles refer to the plummet line and the horizontal directions are corrected by the standing axis tilt. For corrections depending on the **HA Corr:** setting, refer to the table "Tilt and horizontal corrections".
☞	If the instrument is used on an unstable base, for example a shaking platform or ship, the compensator should be deactivated. This avoids the compensator drifting out of it's measuring range and interrupting the measuring process by indicating an error.	
HA Corr.	**On**	Horizontal corrections are activated. For normal operation the horizontal correction should remain active. Each measured horizontal angle will be corrected, depending on the vertical angle. For corrections depending on the **Tilt Corr:** setting, refer to the table "Tilt and horizontal corrections".
	Off	Horizontal corrections are deactivated.
Face I Def.	Sets face I in relation to the position of the vertical drive.	
	VA-Left	Sets face I to be when the vertical drive is on the left of the instrument.

Field	Description	
	VA-Right	Sets face I to be when the vertical drive is on the right of the instrument.
HA Incr.	**Right**	Set horizontal angle to clockwise direction measurement.
	Left	Set horizontal angle to counter-clockwise direction measurement. Counter-clockwise directions are displayed but are saved as clockwise directions.
VA-Setting	Sets the vertical angle.	
	Zenith	 Zenith=0°; Horizon=90°.
	Horizont	 Zenith=90°; Horizon=0°. Vertical angles are positive above the horizon and negative below it.
	Slope %	 45°=100%; Horizon=0°. Vertical angles are expressed in % with positive above the horizon and negative below it. ☞ The % value increases rapidly. --.--% appears on the display above 300%.
Angle Unit	Sets the units shown for all angular fields.	
	° ' "	Degree sexagesimal. Possible angle values: 0° to 359°59'59''
	dec. deg	Degree decimal. Possible angle values: 0° to 359.999°
	gon	Gon. Possible angle values: 0 gon to 399.999 gon
	mil	Mil. Possible angle values: 0 to 6399.99mil.
☞	The setting of the angle units can be changed at any time. The actual displayed values are converted according to the selected unit.	
Min. Reading	Sets the number of decimal places shown for all angular fields. This is for data display and does not apply to data export or storage.	
	For **Angle Unit** **° ' ''**: (0° 00' 01" /0° 00' 05"/0° 00' 10").	

Field	Description	
		Dec.deg: (0.0001 / 0.0005 / 0.001).
		Gon: (0.0001 / 0.0005 / 0.001).
		Mil: (0.01 / 0.05 / 0.1).
Dist. Unit	Sets the units shown for all distance and coordinate related fields.	
	meter	Meters [m].
	ft (US)	US feet [ft].
	ft (INT)	International feet [fi].
	ft-in/16	US feet-inch-1/16 inch [ft].
Temp. Unit	Sets the units shown for all temperature fields.	
	°C	Degree Celsius.
	°F	Degree Fahrenheit.
Press.Unit	Sets the units shown for all pressure fields.	
	hPa	Hecto Pascal.
	mbar	Millibar.
	mmHg	Millimeter mercury.
	inHg	Inch mercury.
Beep	The beep is an acoustic signal after each key stroke.	
	Normal	Normal volume.
	Loud	Increased volume.
	Off	Beep is deactivated.
Sector Beep	**On**	Sector Beep sounds at right angles (0°, 90°, 180°, 270° or 0, 100, 200, 300 gon).  1)No beep. 2)Fast beep; from 95.0 to 99.5 gon and 105.0 to 100.5 gon. 3)Permanent beep; from 99.5 to 99.995 gon and from 100.5 to 100.005 gon.
	Off	Sector Beep is deactivated.
Screen ill.	**On** or **Off**	Sets the screen illumination on or off.

Field	Description	
Crossh ill.	**Low, Medium** or **High**	Sets the illumination level of the crosshairs.
Heating	**On**	The display heater is activated.
	Off	The display heater is deactivated.
☞	The display heater is automatically activated when the display illumination is on and the instrument temperature is ≤ 5°C.	
Data Output	Sets the location for data storage.	
	Int. Mem.	All data is recorded in the internal memory.
	Interface	Data is recorded via the serial interface or the USB device port, depending on the port selected in the **COMMUNICATION SETTINGS** screen. This **Data Output** setting is only required if an external storage device is connected and measurements are started at the instrument with MEAS/REC or ALL. This setting is not required if the instrument is totally controlled by a datalogger.
GSI Format	Sets the GSI output format.	
	GSI 8	81..00+12345678
	GSI 16	81..00+1234567890123456
Mask	Sets the GSI output mask.	
	Mask1	Pt, HA, VA, sDIST, ppm+mm, TgtHGT, Instr.h.
	Mask2	Pt, HA, VA, sDIST, E, N, H, TgtHGT.
Code saving	Sets if the codeblock is saved before or after the measurement. Refer to "7 Coding".	
Language	Sets the chosen language. The current loaded language(s) are shown. A selected language can be deleted by pressing **DelLng**. This function is available if more than one language is installed, and the selected language is not the chosen operating language.	
Auto-Off	**Enable**	The instrument switches off after 20 minutes without any activity , for example no key pressed or vertical and horizontal angle deviation is ≤ ±3".
	Disable	Automatic switch-off is deactivated.
	☞	Battery discharges quicker.

Tilt and horizontal corrections

Setting		Correction			
Tilt correction	**Horizontal correction**	**Incline longitudinal**	**Incline transversal**	**Horizontal collimation**	**Tilting axis**
Off	**On**	No	No	Yes	Yes
1-Axis	**On**	Yes	No	Yes	Yes
2-Axis	**On**	Yes	Yes	Yes	Yes
Off	**Off**	No	No	No	No
1-Axis	**Off**	Yes	No	No	No
2-Axis	**Off**	Yes	No	No	No

4.2 EDM Settings

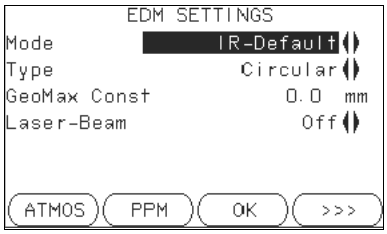
Description

The settings on this screen define the active EDM, **E**lectronic **D**istance **M**easurement. Different settings for measurements are available with Recflectorless (RL) and Prism (IR) EDM modes.

Access

1) Select **Settings** from the **MAIN MENU**.
2) Select **EDM** from the **SETTINGS** menu.

EDM SETTINGS



ATMOS
To enter atmospheric data ppm.

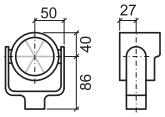
PPM
To enter an individual ppm value.

>>> SCALE
To enter projection scale details.

>>> SIGNAL
To view EDM Signal reflection value.

>>> FREQ.
To view the EDM frequency.

Field	Description	
Mode	**IR-Default**	Fine measuring mode for high precision measurements with prisms.
	IR-Quick	Quick measuring mode with prisms, with higher measuring speed and reduced accuracy.

Field	Description	
	IR-Continuous	For continuous distance measurements with prisms.
	Foil	For distance measurements using Retro reflective targets.
	RL-Default	For distance measurements without prisms.
	RL-Continuous	For continuous distance measurements without prisms.
	RL-Long	For long range distance measurements with prisms.
Type	**Circular**	 Standard prism ZPR100 Stonex® Constant: 0.0 mm
	Custom	The user can define their own prism. Constants can be entered in mm in **Stonex® Const:**
	Foil	Stonex® Constant: +34.4 mm
	None	**RL-modes** Stonex® Constant: +34.4 mm
Stonex® Const.	This field displays the Stonex® prism constant for the selected **Type:** Where **Type:** is **Custom** this field becomes editable to set a user defined constant. Input can only be made in mm. Limit value: -999.9 mm to +999.9 mm.	
Laser-Beam	**Off**	Visible laser beam is deactivated.
	On	Visible laser beam for visualising the target point is activated.

ATMOSPHERIC DATA ENTRY

This screen enables the entry of atmospheric parameters. Distance measurement is influenced directly by the atmospheric conditions of the air in which the measurements are taken. In order to take these influences into consideration distance measurements are corrected using atmospheric correction parameters.
The refraction correction is taken into account in the calculation of the height differences and the horizontal distance. Refer to "14.7 Scale Correction" for the application of the values entered in this screen.

☞ When PPM=0 is selected, the Stonex® standard atmosphere of 1013.25 mbar, 12°C, and 60% relative humidity will be applied.

PROJECTION SCALE

This screen enables entry of the scale of projection. Coordinates are corrected with the PPM parameter. Refer to "14.7 Scale Correction" for the application of the values entered in this screen.

Free-PPM Entry

This screen enables the entry of individual scaling factors. Coordinates and distance measurements are corrected with the PPM parameter. Refer to "14.7 Scale Correction" for the application of the values entered in this screen.

EDM SIGNAL REFLECTION

This screen tests the EDM signal strength (reflection strength) in steps of 1%. Enables optimal aiming at distant, barely visible, targets. A percentage bar and a beeping sound, indicate the reflection strength. The faster the beep the stronger the reflection.

4.3 Communication Settings

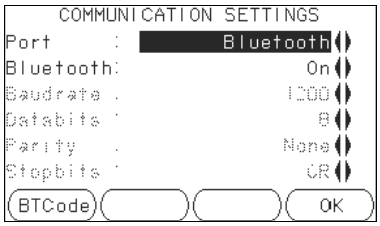
Description

For data transfer the communication parameters of the instrument must be set.

Access

1) Select **Settings** from the **MAIN MENU**.
2) Select **Comm** from the **SETTINGS** menu.

COMMUNICATION SETTINGS



BTCode

To set a code for the Bluetooth connection.

This softkey is only available for R6 instruments. The default Bluetooth code is '0000'.

Field	Description	
Port	Instrument port. For R6 instruments, the options are selectable. For R5 instruments, the value is set to **RS232** and is uneditable.	
	RS232	Communication is via the serial interface.
	USB	Communication is via the USB host port.
	Bluetooth	Communication is via Bluetooth.
	Automatically	Communication is set to auto detect.
Bluetooth	**On**	Bluetooth sensor is activated.

Field	Description	
	Off	Bluetooth sensor is deactivated.

The following fields are active only when **Port: RS232** is set.

Field	Description	
Baudrate	Speed of data transfer from receiver to device in bits per second.	
	1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 115200	
Databits	Number of bits in a block of digital data.	
	7	Data transfer is realised with 7 databits.
	8	Data transfer is realised with 8 databits.
Parity	**Even**	Even parity. Available if data bit is set to 7.
	Odd	Odd parity. Available if data bit is set to 7.
	None	No parity. Available if data bit is set to 8.
Endmark	**CR/LF**	The terminator is a carriage return followed by a line feed.
	CR	The terminator is a carriage return.
Stopbits	**1**	Number of bits at the end of a block of digital data.

5 Tools

5.1 Calibration

Description
The **CALIBRATION** menu contains tools to be used for the electronic calibration of the instrument. Using these tools helps to maintain the measuring accuracy of the instrument.

Access
1) Select **Tools** from the **MAIN MENU**.
2) Select **Calibr.** from the **TOOLS MENU**.
3) Select a calibration option from the **CALIBRATION** screen.

Calibration options
In the **CALIBRATION** screen there are several calibration options.

Menu selection	Description
HA-Collimation	Refer to "11.3 Calibrating Line-of-Sight and Vertical Index Error".
Vertical Index	Refer to "11.3 Calibrating Line-of-Sight and Vertical Index Error".
View Calibration Data	Displays the current calibration values that have been set for HA-Collimation and V-index.

5.2 Auto Start Routine

Description
Through the Auto Start tool, it is possible to record a user defined sequence of key presses so that, after switching on the instrument, a particular screen can be displayed after the **Level & Plummet** screen instead of the **MAIN MENU**. For example, the general **SETTINGS** screen for configuring the instrument settings.

Access
1) Select **Tools** from the **MAIN MENU**.
2) Select **Auto St.** from the **TOOLS MENU**.

Auto start step-by-step
1) Press **REC** in the **AUTO START** screen.
2) Press **OK** to confirm the information message and begin the recording process.

3) The next key presses are stored, up to a maximum of 16. To end the recording press **ESC**.
4) If the auto start **Status**: is set to **On**, the stored key presses will be executed automatically after switching on the instrument.

☞ The automatic start routine has the same effect as pressing the keys manually. Certain instrument settings can not be made in this way. Relative entries such as automatically setting EDM **Mode: IR-Quick** upon switching on the instrument, are not possible.

5.3 System Information

Description

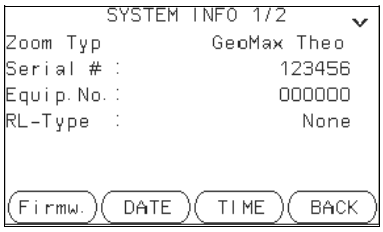
The System information screens display instrument, system and firmware information, as well as settings for the date and time.

Access

1) Select **Tools** from the **MAIN MENU**.
2) Select **SysInfo** from the **TOOLS MENU.**

SYSTEM INFORMATION

This screen displays information about the instrument and operating system.



Firmw.
To display details of the firmware package installed on the instrument.
DATE
To change the date and format.
TIME
To change the time.

Next step
Press **Firmw.** to view the firmware package information.

SOFTWARE-INFORMATION

☞ Before selecting **FORMAT**, to format the internal memory, ensure that all important data is first transferred to a computer. Jobs, formats, codelists, configuration files, uploaded languages and firmware will be deleted by formatting.

Field	Description
R5/R6-FW. Versi	Displays the firmware version number installed on the instrument.
Build	Displays the build number of the firmware.
Current Lang	Displays the current language and version number selected for the instrument.

Field	Description
EDM-Firmware	Displays the version number of the EDM firmware.
Application Information	Displays a list of the applications available on the instrument.

5.4 Loading Software

Description

To load application software or an additional language, connect the instrument to Stonex Software via the serial interface and load using "Stonex Software - Software Upload". Refer to the Stonex Software online help for further information.
For R6 instruments, the software can be loaded via a USB memory stick. This process is described below.

Access

1) Select **Tools** from the **MAIN MENU**.
2) Select **Load FW** from the **TOOLS MENU**.

- **Load FW** is only an option on the **TOOLS MENU** for R6 instruments.
- Never disconnect the power supply during the system upload process. The battery must be at least 75% capacity before commencing the upload.

Loading firmware and languages step-by-step

1) To load firmware and languages: Select **R5/R6 Firmware**. The **Select File** screen will appear.
   To load only languages: Select **R5/R6 Languages only** and skip to step 4
2 Select the firmware file from the system folder of the USB memory stick. All firmware and language files must be stored in the system folder to be transferred to the instrument.
3 Press **OK**.
4 The **Upload Languages** screen will appear displaying all language files in the system folder of the USB memory stick. Select **Yes** or **No** for a language file to be uploaded. At least one language must be set to **Yes**.
5 Press **OK**.
6 Press **Yes** on the power warning message to proceed and upload the firmware and/or selected languages.
7 Once successfully loaded, the system will shutdown and restart again automatically.

6 Functions

6.1 Overview

Description

Functions can be accessed by pressing **FNC** from any measurement screen. **FNC** opens the functions menu and a function can be selected and activated.

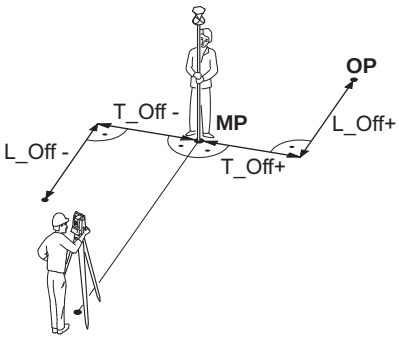
Functions

Function	Description
Level & Plummet	Activates the laser plummet and electronic level.
Distance Offset	Refer to "6.2 Distance Offset".
RL/IR Change	Changes between the two EDM modes. Refer to "4.2 EDM Settings".
Delete Last Observ.	Deletes the last recorded data block. This can be either a measurement block or a code block. ☞ Deleting the last record is **not** reversible! Only records recorded in Survey can be deleted.
Code-Library	Starts Coding application to select a code from a codelist or enter a new code. Same functionality like the softkey **CODING**.
Laserbeam	Activates/deactivates the visible laser beam for illuminating the target point.
Screen ill. On /Off	Activates and deactivates the screen illumination light.
Distance unit	Sets the distance measurement unit.
Angle unit	Sets the angle measurement unit.
Z-Coordinate	Refer to "6.3 Z-Coordinate".
2 Dist. Offset	Refer to "6.4 2 Dist. Offset".
Control Distance	Refer to "6.5 Control Distance".
Settings	Refer to "4.1 General Settings".
EDM Continuous	Refer to "6.6 EDM Continuous".
Menu	Returns to the **MAIN MENU**.

6.2 Distance Offset

Description

This function calculates the target point coordinates if it is not possible to set up the reflector, or to aim at the target point directly. The offset values (length, trav. and/or height offset) can be entered. The values for the angles and distances are calculated to determine the target point.

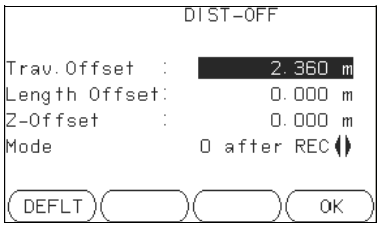


MP Measurement point
OP Offset point
T_Off Length offset
L_Off Cross offset

Access

1) Press **FNC** when within any application.
2) Select **Distance Offset** from the **FUNCTIONS** menu.

DIST-OFF



DEFLT
To reset offset values to 0.

Field	Description
Trav. Offset	Perpendicular offset. Positive if the offset point is to the right of the measured point.
Length Offset	Longitudinal offset. Positive if the offset point is further away than the measured point.
Z-Offset	Height offset. Positive if the offset point is higher than the measured point.
Mode	Period for which the offset is to apply. **0 after REC** The offset values are reset to 0 after the point is saved. **Continuous** The offset values are applied to all further measurements.
☞	The offset values are always reset to 0 when the application is quit.

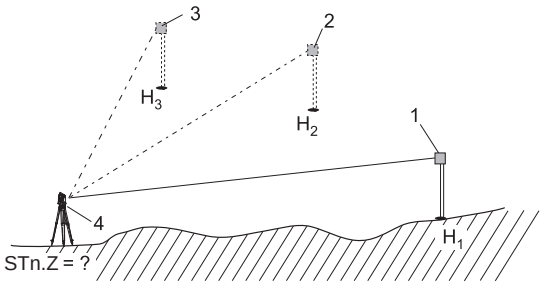
Next step

- Press **OK** to calculate the corrected values and return to the application from which the offset function was started. The corrected angle and distances are displayed as soon as a valid distance measurement has been triggered or exists.

6.3 Z-Coordinate

Description

This function determines the height of the instrument from measurements to a maximum of five target points, with known heights, in two faces.
With measurements to several targets, the improvement is indicated in the "d" value.



1 Reflector 1
2 Reflector 2
3 Reflector 3
4 Instrument

Access

1) Press **FNC** when within any application.
2) Select **Z-Coordinate** from the **FUNCTIONS** menu.

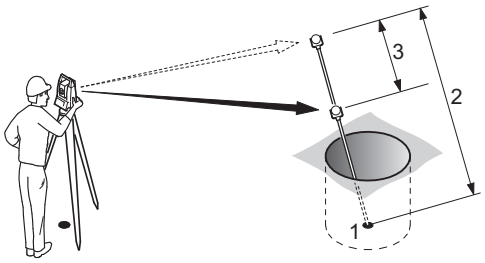
Z-Coordinate step-by-step

1) Select a known point and input the reflector height. Select;
   - **PtHgt**: To enter the height of a fixpoint.
   - **Inst.h.**: To enter the height transfer values for the instrument.
2) Press **ALL** to complete the measurement and display the calculated height.
   - **AddTg**: Adds another height of a known point.
   - **FACE**: Measures to the same target in second face.
   - **OK**: Saves the changes and sets the station height.

6.4 2 Dist. Offset

Description

This function is used for measurements to a point that is not directly visible, using a special 2 Dist. Offset pole.



1 E, N, H of Target Point
2 Pole Length
3 Distance P1-P2

Access

1) Press **FNC** when within any application.
2) Select **2 Dist. Offset** from the **FUNCTIONS** menu.

Next step

If required, press **POLE** to define the pole or EDM settings.

POLE SETTINGS

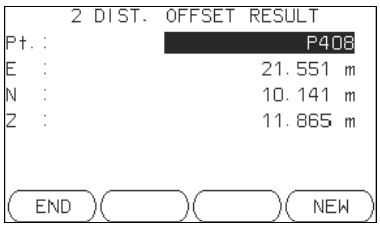
Field	Description
Mode	Changes the EDM Mode.
Type	Changes the prism type.
Stonex® Const	Displays the prism constant.
Pole Length	Total length of 2 Dist. Offset pole
Dist. P1-P2	Spacing between the centers of the prisms P1 and P2.
Meas. Tol	Limit for the difference between the given and measured spacing of the prisms. If the tolerance value is exceeded, the function will issue a warning.

Next step

In the **2 DIST. OFFSET** screen, measure to the first and second prisms using **ALL** and the **2 DIST. OFFSET RESULT** screen is displayed.

2 DIST. OFFSET RESULT

Displays Easting, Northing and Height coordinates of the target point.



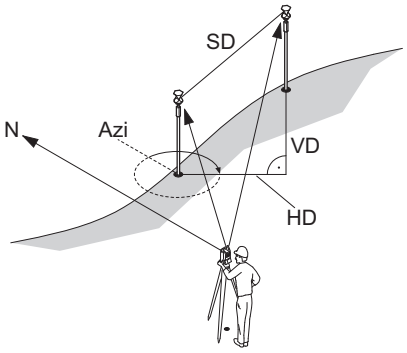
END
To record results and return to application where **FNC** was selected.

NEW
To return to the **2 DIST. OFFSET** screen.

Next step
Press **END** to return to the application where **FNC** was selected.

6.5 Control Distance

Description
This function calculates and displays the slope and horizontal distance, height difference, azimuth, grade, and coordinate differences between the last two measured points. Valid distance measurements are required for the calculation.



Azi Azimuth
SD Slope distance
VD Height distance
HD Horizontal distance

Access
1) Press **FNC** when within any application.
2) Select **Control Distance** from the **FUNCTIONS** menu.

CONTROL DISTANCE

Field	Description
Brg	Difference in bearing between the two points.
Grade	Difference in gradient between the two points.
hDIST	Difference in horizontal distance between the two points.
sDIST	Difference in slope distance between the two points.
d.d.Z	Difference in height between the two points.

Messages
The following are important messages or warnings that may appear.

Messages	Description
Less than two valid measurements!	The values cannot be calculated as there are less than two valid measurements.

Next step
Press **OK** to return to the application where **FNC** was selected.

6.6 EDM Continuous

Description
This function activates or deactivates the tracking measurement mode. The new setting is displayed for about one second and then set. The function can only be activated from within the same EDM mode and prism type. The following options are available.

Mode	Off <=> On
IR	IR-Default <=> IR-Continuous / IR-Quick <=> IR-Continuous.
RL	RL-Default <=> RL-Continuous.

The last active measurement mode remains set when the instrument is switched off.

7 Coding

Description

Codes contain information about recorded points. With the help of coding, points can be assigned to a particular group simplifying later processing.
Codes are stored in codelists, with each codelist supporting a maximum of 200 codes.

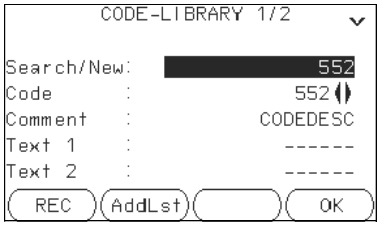
GSI coding

Codes are always stored as free codes (WI41-49), that means that codes are not directly linked to a point. They are stored before or after the measurement depending on the setting made.
Point codes (WI71-79) are not available.
A code is always recorded for each measurement as long as the code is displayed in the **Code:** field. For a code not to be recorded, the **Code:** field must be cleared. This can be set to occur automatically. Refer to "4.1 General Settings".

Access

- Either, select **Survey** from the **MAIN MENU** and press >>> **CODING**.
- Or, press **FNC** when within any application and select **Code Library.**

CODE-LIBRARY



REC
To record the code without measurement.
AddLst
To add the entered code to the codelist.

Field	Description
Search/New	Code name. After entry, the firmware searches for a matching code name, and displays these in the code field. If a matching code name doesn't exist this value becomes the new code name.
Code	List of existing code names.
Comment	Additional remarks.
Text1 to **Text8**	More information lines, freely editable. Used to describe attributes of the code.

Extend / edit codes

To each code a description and a maximum of 8 attributes with up to 16 characters each can be assigned. Existing code attributes, displayed in fields **Text 1:** to **Text 8:**, can be overwritten freely with the following exceptions:

The codelist editor of Stonex Software can assign a status to the attributes.

- Attributes with status "fixed" are write-protected. They cannot be overwritten or edited.
- For attributes with status "Mandatory" an input or a confirmation is required.
- Attributes with status "Normal" can be edited freely.

8 Applications - Getting Started

8.1 Overview

Description

Applications are predefined programs, that cover a wide spectrum of surveying duties and facilitate daily work in the field. The following applications are available, although application packages for each instrument may vary from that stated below:

- Survey
- Reference Element
- COGO
- Missing Line Measurement
- Resection
- Set Out
- Area & Volume
- Remote Elevation
- Construction

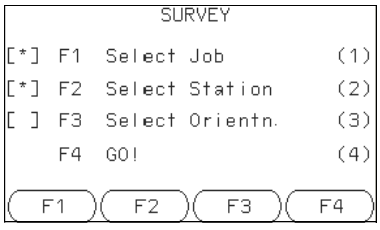
8.2 Starting an Application

Access

1) Select **Apps** from the **MAIN MENU**.
2) Press to move through the screens of available applications.
3) Press a function key, **F1** - **F4**, to select the specified application in the **APPS** menu.

Pre-settings screens

Pre-settings for Survey is shown as an example. Any additional settings for particular applications are explained within the chapters for those applications.



[•] = Setting has been made.
[ ] = Setting has not been made.

F1-F4
To select menu item.

Field	Description
Select Job	To define the job where data will be saved. Refer to "8.3 Selecting the Job".
Select Station	To define the current position of the instrument station. Refer to "8.4 Selecting the Station".
Select Orientn.	To define the orientation, horizontal direction, of the instrument station. Refer to "8.5 Selecting the Orientation".

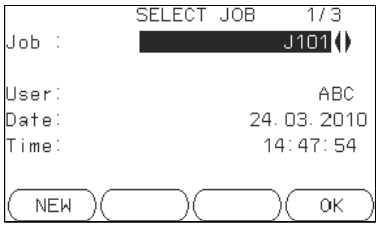
Field	Description
Go!	Starts the selected application.

8.3 Selecting the Job

Description
All data is saved in Jobs, like file directories. Jobs contain measurement data of different types, for example measurements, codes, fixed points, or stations. Jobs are individually manageable and can be exported, edited or deleted separately.

Access
Select **Select Job** in **Pre-settings** screen.

SELECT JOB



NEW
To create a new job.

Field	Description
Job	Name of an existing job to be used.
User	Name of user, if entered.
Date	Date the selected job was created.
Time	Time the selected job was created.

Next step
- Either, press **OK** to continue with the selected job.
- Or, press **NEW** to open the **NEW JOB** screen and create a new job.

Recorded data
Once a job is set up, all subsequent recorded data will be stored in this job.
If no job was defined and an application was started, or if in **Survey** and a measurement was recorded, then the system automatically creates a new job and names it "DEFAULT".

Next step
Press **OK** to confirm the job and return to the **Pre-Settings** screen.

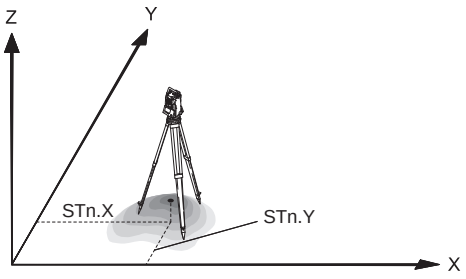
8.4 Selecting the Station

Description

All measurements and coordinate computations are referenced to the set station coordinates. The station coordinates that are set must include:

- at least grid coordinates (E, N), and
- the station height, if required.

The coordinates can be entered manually or selected from the memory.



Directions

X Easting
Y Northing
Z Height

Station coordinates

Stn.X Easting coordinate of station
Stn.Y Northing coordinate of station

Access

Select **Select Station** in the **Pre-settings** screen.

Station input

Field	Description
Stn	Station name of a previously saved station position.

☞ If no station was set and an application was started, or if in **Survey** and a measurement was recorded, then the last station is set as the current station.

Next step

The **Inst.H**. field appears once the station coordinates have been entered. Enter the instrument height if desired and press **OK** to return to the **Pre-Settings** screen.

8.5 Selecting the Orientation

8.5.1 Overview

Description

All measurements and coordinate computations are referenced to the orientation of the set station. The orientation can be entered manually or determined from points that are either measured or selected from the memory.

Access

Select **Select Orientn.** in the **Pre-settings** screen and choose:

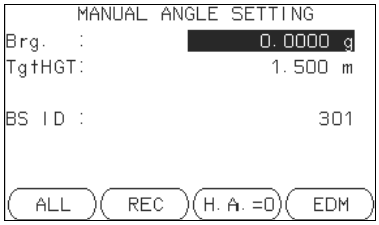
- **Angle** To enter a new bearing. Refer to "8.5.2 Manual Orientation".
- **Coordinates** To calculate and set the orientation using existing coordinates. A maximum of five target points can be used. Refer to "8.5.3 Orientation with Coordinates".

8.5.2 Manual Orientation

Access

Select **Angle** in the **STN.ORIENTATION** screen.

MANUAL ANGLE SETTING



HA=0
To set **Brg:** 0

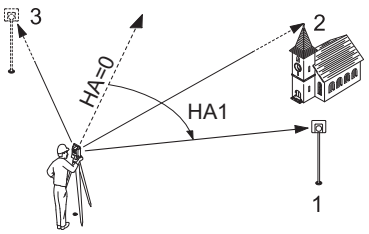
Field	Description
Brg	Horizontal direction of the station.
TgtHGT.	Height of the reflector.
BS ID	Point ID of the backsight point.

Next step

- Either, press **ALL** to measure and record the distance and horizontal angles. This will calculate and set the orientation and return to the **Pre-Settings** screen.
- Or, press **REC** to record the horizontal direction only. This will set the orientation and return to the **Pre-Settings** screen.

8.5.3 Orientation with Coordinates

Diagram



Known coordinates
1 Target point
2 Target point
3 Target point
Calcuations
HA1 Station orientation

Access
Select **Coordinates** in the **STN-ORIENTATION** screen.

Orientation with coordinates

Field	Description
Pt.	Point ID of the backsight point.

Next step
Find an existing backsight point in the pointsearch or enter ENZ coordinates for a new point. Press **OK** to continue to **Sight target point**.

Sight target point

Field	Description
BS ID	Point ID of the selected, or entered backsight point.

Next step
After each measurement the message, **Do you want to take additional measurements** appears. Selecting:

- **Yes** returns to the **Sight target point** screen to take an additional measurement. A maximum of five target points can be used.
- **No** proceeds to the **STN. ORIENTATION RESULT** screen.

Result calculation
If more than one target point is measured then the orientation is computed using the "least squares method".

IF	THEN
the orientation is only measured in face II	the horizontal direction is based on face II.
the orientation is measured only in face I or a mixture of I and II	the horizontal direction is based on face I.
a target point is measured several times in the same face	the last valid measurement is used for the computation.

Stn. Orientation result

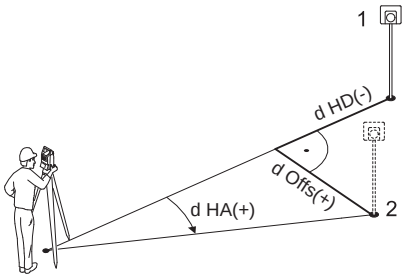
Field	Description
Pts	Number of points used in the calculation.
Stn	Station name for which the orientation has been set.
HA Corr	Horizontal correction

Field	Description
Std.Dev	Standard deviation indicating the potential variance between the true orientation and that calculated.

Next step

- Either, press **Resid** to display the residuals.
- Or, press **OK** to set the orientation and return to the **Pre-Settings** screen.

Stn. Orientation Residuals



1 Actual
2 Design
P2 Target point
d Offs Height correction
d HD Correction in horizontal distance
d HA Correction in horizontal direction

Field	Description
BS ID	Point IDs of the target points used in calculating the orientation.
d.H.A	The difference in horizontal direction to the target point.
d.H.D	The difference in horizontal distance to the target point.
dZ	The difference in height to the target point.

If no orientation was set and an application was started, or if in **Survey** and a measurement was recorded, then the current horizontal direction is set as the orientation.

Next step

Select **GO!** to begin the application.

9 Applications

9.1 Common Fields

Description of fields

The following table describes common fields that are found within the firmware applications. These fields are described here once and not repeated in the application chapters unless the field has a specific meaning within that application.

Field	Description
Pt, Pt 1	Point ID of the point.
TgtHGT	Height of the reflector.
HA	Horizontal direction to the point.
VA	Vertical angle to the point.
hDIST	Horizontal distance to the point.
sDIST	Slope distance to the point.
dHGT	Height to the point.
E	Easting coordinate of the point.
N	Northing coordinate of the point.
Z	Height coordinate of the point.

9.2 Survey

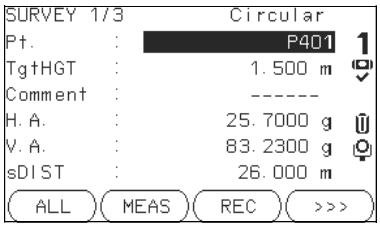
Description

Survey is an application used for the measurement of an unlimited number of points. It is comparable to **Survey** from the **MAIN MENU**, but includes pre-settings for the job, station and orientation prior to beginning a survey.

Access

1) Select **Apps** from the **MAIN MENU**.
2) Select **Survey** from the **APPS** menu.
3) Complete application pre-settings. Refer to "8 Applications - Getting Started".

SURVEY



>>> **I Pt**
To switch between individual and current point numbers.
>>> **CODING**
To find/enter codes. Refer to "7 Coding".

Field	Description
Comment / Code	Comment or Code name depending on the coding method. Two coding methods are available: 1) Comment coding: This text is stored with the corresponding measurement. The code is not related to a codelist, it is just a simple comment. A codelist on the instrument is not necessary. 2) Expanded coding with codelist: Press >>> **CODING**. The code that was entered is searched for within the code list and it is possible to add attributes to the code.

Next step
- Either, press **ALL** to record another point.
- Or, press **ESC** to exit the application.

9.3 Reference Element - Reference Line

9.3.1 Overview

Description
Reference Element - Line is an application that facilitates the easy set out or checking of lines, for example, for buildings, sections of road, or simple excavations. It allows the user to define a reference line and then complete the following tasks with respect to that line:
- Line & offset
- Set out points

Access
1) Select **Apps** from the **MAIN MENU**.
2) Select **Reference Element** from the **APPS** menu.
3) Complete application pre-settings. Refer to "8 Applications - Getting Started".
4) Select **Line**

Next step
Define the base line for the reference line.

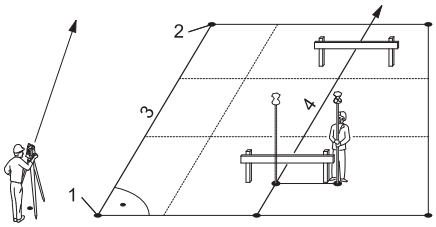
9.3.2 Defining the Base Line

Description

A reference line can be defined by referencing a known base line. The reference line can be offset either longitudinally, in parallel or vertically to the base line, or be rotated around the first base point as required. Furthermore the reference height can be selected as the first point, second point or interpolated along the reference line.

Define the base line

The base line is fixed by two base points. All points can be either measured, manually entered, or selected from the memory.



1 1st base point
2 2nd base point
3 Base line
4 Reference line

Define the base line by measuring or selecting the start and end points of the line.

Next step

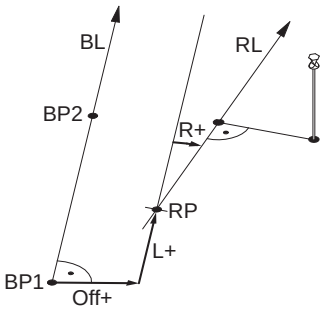
After defining the base line the **REFERENCE LINE** screen will appear for defining the reference line.

9.3.3 Defining the Reference Line

Description

The base line can be offset from, either longitudinally, in parallel or vertically, or be rotated around the first base point. This new line created from the offsets is called the reference line. All measured data refers to the reference line.

Reference line

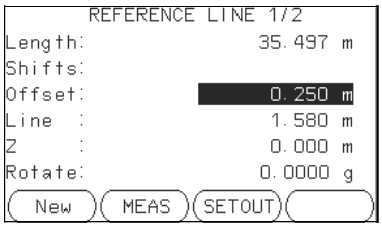


BP Base point
BL Base line
RP Reference point
RL Reference line
Off Parallel offset
L Longitudinal offset
R Rotation parameter

Access

After completing the measurements required for defining the base line, the **REFERENCE LINE** screen will appear.

REFERENCE LINE



New
To define a new base line.

MEAS
To measure Line & Offset.

SETOUT
To set out points orthogonal to the reference line.

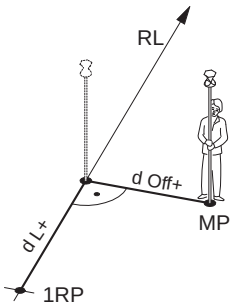
Field	Description	
Length	Length of the base line.	
Offset	Parallel offset of the reference line relative to the base line (P1-P2). Positive values are to the right of the base line.	
Line	Longitudinal offset of the start point, reference point (P3), of the reference line in the direction of base point 2. Positive values are towards base point 2.	
Z	Height offset of the reference line to the selected reference height. Positive values are higher than the selected reference height.	
Rotate	Rotation of the reference line clockwise around the reference point (P3).	
Ref.Hgt	**Pt. 1**	Height differences are computed relative to the height of the first reference point.
	Pt. 2	Height differences are computed relative to the height of the second reference point.
	Interpolated	Height differences are computed along the reference line.
	w/o. Height	Height differences are not computed or shown.

Next step
Select a softkey option, **MEAS** or **SETOUT** to proceed to a subapplication.

9.3.4 Subapplication Measure Line & Offset

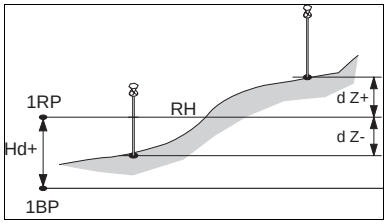
Description

The Measure Line & Offset subapplication calculates from measurements or coordinates, longitudinal offsets, parallel offsets and height differences of the target point relative to the reference line.



RL Reference line
1RPStart point
MP Measured point
dL Longitudinal offset
dOffParallel offset

Example of height difference relative to first reference point



1RP1st reference point
1BP1st base point
RH Reference height
Hd Height difference between reference and base point
d Z Height difference from reference height

Access

Press **MEAS** in the **REFERENCE LINE** screen.

Measure

Field	Description
d Line	Calculated distance longitudinal to the reference line.
d Offset	Calculated distance perpendicular from the reference line.
d.d.Z	Calculated height difference relative to the defined reference height.

Next step

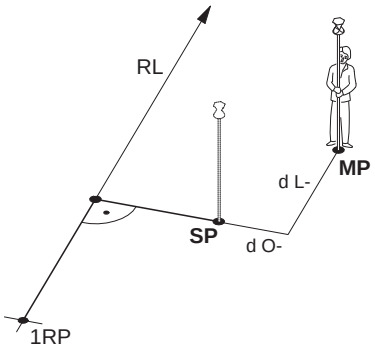
- Either, press **ALL** to measure and record.
- Or, press >>> **BACK** to return to the **REFERENCE LINE** screen.

9.3.5 Subapplication Setout

Description

The setout subapplication calculates the difference between a measured point and the calculated point. The orthogonal (dLine, dOffset, d.d.Z) and polar (dHA, d.hDIST, d.d.Z) differences are displayed.

Example orthogonal setout



1RP 1st reference point
SP Set out point
MP Measured point
RL Reference line
dL Longitudinal offset
dO Parallel offset

Access

Press **SETOUT** from the **REFERENCE LINE** screen.

SETOUT

Enter the set out elements for the target points to be set out relative to the reference line.

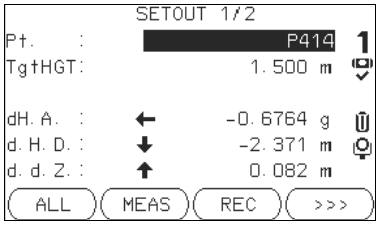
Field	Description
Line	Longitudinal offset: Positive if set out point is further away from the reference line.
Offset	Perpendicular offset: Positive if set out point is to the right of the reference line.
Z	Height offset: Positive if set out point is higher than the reference line.

Next step

Press **OK** to proceed to measurement mode.

SET OUT

The signs for the distance and angle differences are correction values (required minus actual). The arrows indicate the direction to move to get to the set out point.



>>> NextPt
To add the next point to be set out.

Field	Description
d HA	Horizontal direction from the measured point to the set out point. Positive if the telescope must be turned clockwise to the set out point.
d.H.D	Horizontal distance from the measured point to the set out point. Positive if the set out point is further away than the measured point.
d.d.Z	Height difference from the measured point to the set out point. Positive if the set out point is higher than the measured point.
dOffset	Perpendicular distance from the measured point to the set out point. Positive if the set out point is to the right of the measured point.
dLine	Longitudinal distance from the measured point to the set out point. Positive if the set out point is further away than the measured point.

Messages

The following are important messages or warnings that may appear.

Messages	Description
Base line too short !	Base line is shorter than 1 cm. Choose base points such that the horizontal separation of both points is at least 1 cm.
Coordinates invalid !	No coordinates or invalid coordinates for a point. Ensure that points used have at least Easting and Northing coordinates.
Save via RS232 !	**Data Output**: is set to RS232 in the **SETTINGS** menu. To be able to successfully start reference element, **Data Output:** must be set to **Internal**.

Next step

- Either, press **ALL** to measure and record.
- Or, press >>> **BACK** to return to the **REFERENCE LINE** screen.
- Or, continue selecting **ESC** to exit the application.

9.4 Reference Element - Reference Arc

9.4.1 Overview

Description

The Reference Element - Arc application allows the user to define a reference arc and then complete the following tasks with respect to the arc:

- Line & offset
- Set out (Point, Arc, Chord, Angle)

Access

1) Select **Apps** from the **MAIN MENU**.
2) Select **Reference Element** from the **APPS** menu.
3) Complete application pre-settings. Refer to "8 Applications - Getting Started".
4) Select **Arc**.

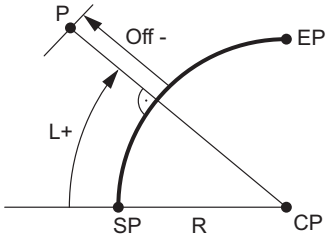
Next step

Define the reference arc.

9.4.2 Defining the Reference Arc

Description

The reference arc can be defined by a center point and start point, or a start point, end point, and radius. All points can be either measured, manually entered, or selected from the memory.



SP Start point
EP End point
CP Center point
R Radius of arc
L Distance from start of arc, following curve
Off Perpendicular distance from arc

All arcs are defined in a clockwise direction and all calculations are made in two dimensions.

Access

Select **Arc** and then the method to define the arc by:

- **Start-/ Centre Pt**.
- **Start-/ End Pt/ Rad**.

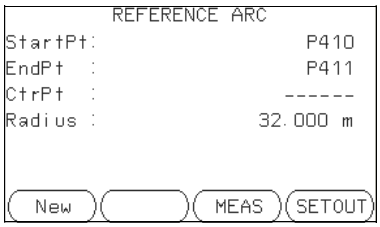
Reference Arc - Measure to start point

Field	Description
Start Pt	Point ID of the start point.
C-Pt	Point ID of the center point.
End Pt	Point ID of the end point.
Radius	Radius of the arc.

Next step

After defining the reference arc the **REFERENCE ARC** screen will appear.

REFERENCE ARC



New
To define a new base arc.
MEAS
To measure Line & Offset.
SET OUT
To set out.

Next step
Select a softkey option, **MEAS** or **SET OUT**, to proceed a subapplication.

9.4.3 Subapplication Measure Line & Offset

Description
The Measure Line & Offset subapplication calculates from measurements or coordinates, longitudinal and orthogonal offsets and height differences of the target point relative to the reference arc.

Access
Press **MEAS** from the **REFERENCE ARC** screen.

Measure

Field	Description
dLine	Calculated distance longitudinal to the reference arc.
dOffset	Calculated distance perpendicular from the reference arc.
d.d.Z	Calculated height difference relative to the start point of reference arc.

Next step
- Either, press **ALL** to measure and record.
- Or, press >>> **BACK** to return to the **REFERENCE ARC** screen.

9.4.4 Subapplication Setout

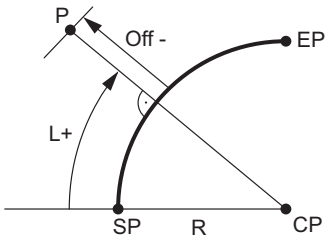
Description

The setout subapplication calculates the difference between a measured point and the calculated point. The reference arc application supports four ways to set out:

- Set out point
- Set out arc
- Set out chord
- Set out angle

Set out point

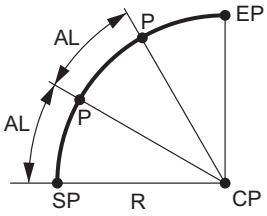
To set out a point by entering a line and an offset value.



CP Center point of arc
SP Start point of arc
EP End point of arc
P Set out point
R Radius of arc
L Line offset
Off Perpendicular offset

Set out arc

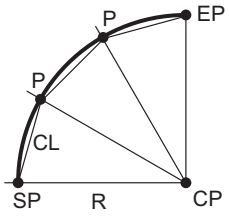
To set out a series of equidistant points along the arc.



CP Center point of arc
SP Start point of arc
EP End point of arc
P Set out point(s)
R Radius of arc
AL Arc length

Set out chord

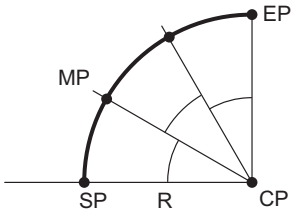
To set out a series of equidistant chords along the arc.



CP Center point of arc
SP Start point of arc
EP End point of arc
P Set out point(s)
R Radius of arc
CL Chord length

Set out angle

To set out a series of points along the arc defined by the angle segments from the center point of the arc.



CP Center point of arc
SP Start point of arc
EP End point of arc
MP Measured point
R Radius of arc
b Central angle

Access

1) Press **SET OUT** from the **REFERENCE ARC** screen.
2) Select one of the four methods of set out available.

Set out point, arc, chord or angle

Enter the set out values. Press **PrevPt/NextPt** to toggle through the calculated set out points.

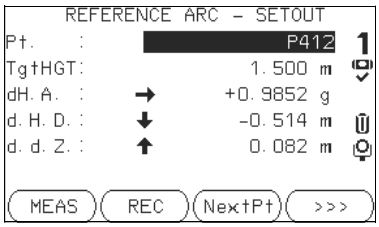
Field	Description
Distrib.	For set out arc: Method of misclosure distribution. If the entered arc length is not an integer of the whole arc, there will be a misclosure. **None** All of the misclosure will be added to the last arc-section. **Equal** The misclosure will be equally distributed between all sections. **Start Arc** All of the misclosure will be added to the first arc-section.
Arc Length	For set out arc: The length of the arc-segment to set out.
Chord Length	For set out chord: The length of the chord to set out.
Angle	For set out angle: The angle around the center point of the arc, of the points to be set out.
Line	For set out arc, chord and angle: Longitudinal offset from the reference arc. This is calculated by the arc length, chord length or angle and the selected misclosure distribution. For set out point: Longitudinal offset from the reference arc.
Offset	Perpendicular offset from the reference arc.

Next step

Press **OK** to proceed to measurement mode.

REFERENCE ARC - SET OUT

The signs for the distance and angle differences are correction values (required minus actual). The arrows indicate the direction to move to get to the set out point.



NextPt
To add the next point to be set out.

Field	Description
d HA	Horizontal direction from the measured point to the set out point. Positive if the telescope must be turned clockwise to the set out point.
d.H.D	Horizontal distance from the measured point to the set out point. Positive if the set out point is further away than the measured point.
d.d.Z	Height difference from the measured point to the set out point. Positive if the set out point is higher than the measured point.

Next step
- Either, press >>> **ALL** to measure and record.
- Or, press >>> **BACK** to return to the **REFERENCE ARC** screen.
- Or, continue selecting **ESC** to exit the application.

9.5 COGO

9.5.1 Starting COGO

Description
COGO is an application used to perform **co**ordinate **g**e**o**metry calculations such as, coordinates of points, bearings between points and distances between points
The COGO calculation methods are:

- Inverse and Traverse
- Intersections
- Offset
- Extension

Access
1) Select **Apps** from the **MAIN MENU**.
2) Select **COGO** from the **APPS** menu.
3) Complete application pre-settings. Refer to "8 Applications - Getting Started".
4) Select from the **COGO MAIN MENU**:
   - **Inverse & Traverse**
   - **Intersection**
   - **Offset**
   - **Extension**

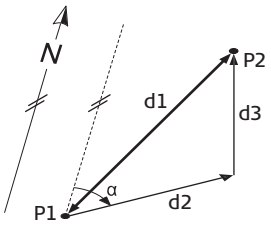
9.5.2 Inverse and Traverse

Access

1) Select **Inverse & Traverse** from the **COGO MAIN MENU**.
2) Select **Inverse** or **Traverse**.

Inverse

Use the inverse subapplication to calculate the distance, direction, height difference and grade between two known points.



Known

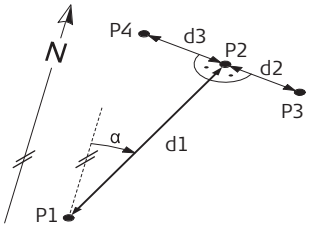
P1 First known point
P2 Second known point

Unknown

α Direction from P1 to P2
d1 Slope distance between P1 and P2
d2 Horizontal distance between P1 and P2
d3 Height difference between P1 and P2

Traverse

Use the traverse subapplication to calculate the position of a new point using the bearing and the distance from a known point. Offset optional.



Known

P1 Known point
α Direction from P1 to P2
d1 Distance between P1 and P2
d2 Positive offset to the right
d3 Negative offset to the left

Unknown

P2 COGO point without offset
P3 COGO point with positive offset
P4 COGO point with negative offset

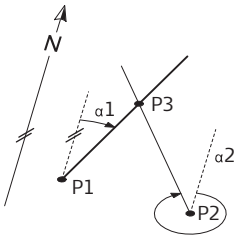
9.5.3 Intersections

Access

1) Select **Intersection** from the **COGO MAIN MENU**.
2) Select the desired COGO method:
   - **Brg-Brg**
   - **Brg-Dst**
   - **Dst-Dst**
   - **Ln-Ln**

Bearing-Bearing

Use the bearing-bearing subapplication to calculate the intersection point of two lines. A line is defined by a point and a direction.



Known

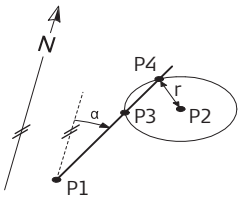
P1 First known point
P2 Second known point
α1 Direction from P1 to P3
α2 Direction from P2 to P3

Unknown

P3 COGO point

Bearing-Distance

Use the bearing-distance subapplication to calculate the intersection point of a line and a circle. The line is defined by a point and a direction. The circle is defined by the center point and the radius.



Known

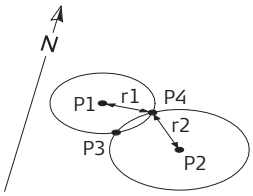
P1 First known point
P2 Second known point
α Direction from P1 to P3 and P4
r Radius, as the distance from P2 to P4 or P3

Unknown

P3 First COGO point
P4 Second COGO point

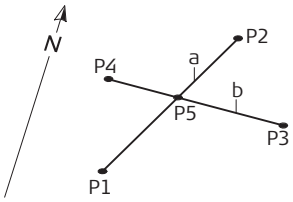
Distance-Distance

Use the distance-distance subapplication to calculate the intersection point of two circles. The circles are defined by the known point as the center point and the distance from the known point to the COGO point as the radius.



Known
P1 First known point
P2 Second known point
r1 Radius, as the distance from P1 to P3 or P4
r2 Radius, as the distance from P2 to P3 or P4
Unknown
P3 First COGO point
P4 Second COGO point

By Points
Use the line-line subapplication to calculate the intersection point of two lines. A line is defined by two points.

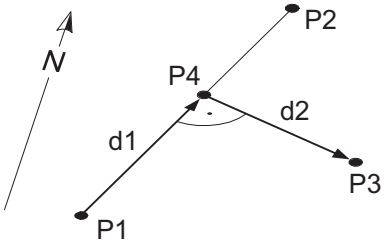


Known
P1 First known point
P2 Second known point
P3 Third known point
P4 Fourth known point
a Line from P1 to P2
b Line from P3 to P4
Unknown
P5 COGO point

9.5.4 Offsets

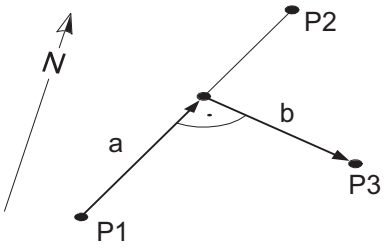
Access
1) Select **Offset** from the **COGO MAIN MENU**.
2) Select the desired COGO method:
   - **DistOff**
   - **Set Pt**

Distance - Offset
Use the distance-offset subapplication to calculate the distance and offset of a known point, with the basepoint in relation to a line.



Known
P0 Instrument station
P1 Start point
P2 End point
P3 Offset point
Unknown
d1 d Line
d2 d Offset
P4 COGO (base) point

Set point by....
Use the set point subapplication to calculate the coordinates of a new point in relation to a line from known longitudinal and offset distances.

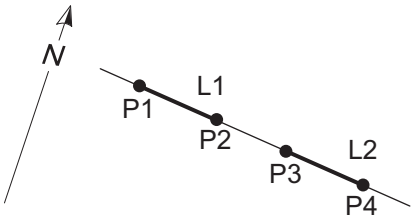


Known
P0 Instrument station
P1 Start point
P2 End point
d1 d Line
d2 d Offset
Unknown
P3 COGO point

9.5.5 Extension

Access
Select **Extension** from the **COGO MAIN MENU**.

Extension
Use the Extension subapplication to calculate the extended point from a known base line.



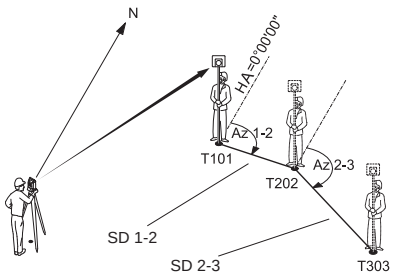
Known
P1 Baseline start point
P3 Baseline end point
dL1,dL2 Distance
Unknown
P2, P4Extended COGO points

9.6 Missing Line Measurement

Description
Missing Line Measurement is an application used to compute slope distance, horizontal distance, height difference and azimuth of two target points which are either measured, selected from the memory, or entered using the keypad.

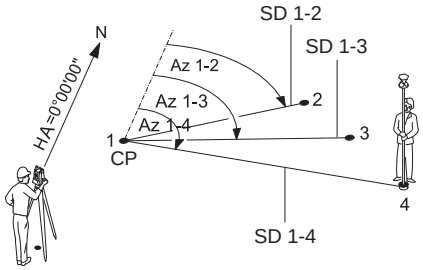
Missing Line Measurement methods
The user can choose between two different methods:
- Polygonal: P1-P2, P2-P3, P3-P4.
- Radial: P1-P2, P1-P3, P1-P4.

Polygonal method



T101 1st target point
T202 2nd target point
T303 3rd target point
SD 1-2Slope distance from T101-T202
SD 2-3Slope distance from T202-T303
Az 1-2Azimuth from T101-T202
Az 2-3Azimuth from T202-T303

Radial method



1-4 Target points
SD 1-2Slope distance from 1-2
SD 1-3Slope distance from 1-3
SD 1-4Slope distance from 1-4
Az 1-2Azimuth from 1-2
Az 1-3Azimuth from 1-3
Az 1-4Azimuth from 1-4
CP Center point

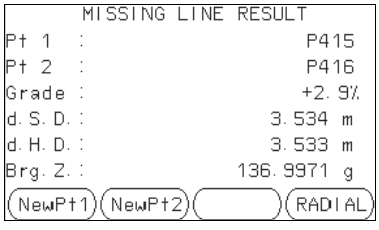
Access

1) Select **Apps** from the **MAIN MENU**.
2) Select **Missing Line Meas.** from the **APPS** menu.
3) Complete application pre-settings. Refer to "8 Applications - Getting Started".
4) Select **Polygon** or **Radial**.

Missing line measurements

After completing the measurements required, the **MLM RESULT** screen will appear.

MISSING LINE RESULT - Polygonal method



NewPt 1
To calculate an additional line. Application starts again at point 1.

NewPt 2
To set point 2 as the starting point of a new line. A new point 2 must be measured.

RADIAL
To switch to radial method.

Field	Description
Grade	Grade [%] between point 1 and point 2.
d.S.D	Slope distance between point 1 and point 2.

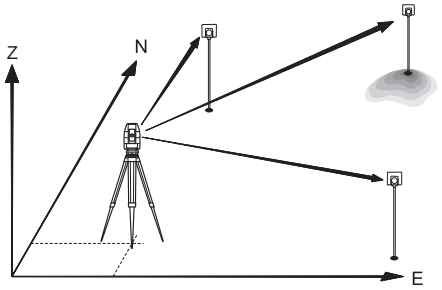
Field	Description
d.H.D	Horizontal distance between point 1 and point 2.
d.d.Z	Height difference between point 1 and point 2.
Brg	Azimuth between point 1 and point 2.

Next step
Press **ESC** to exit the application.

9.7 Resection

9.7.1 Starting Resection

Description
Resection is an application used to determine the instruments position from measurements to known points. A minimum of two known points and a maximum of 5, can be used to determine the position.



Access
1) Select **Apps** from the **MAIN MENU**.
2) Select **Resection** from the **APPS** menu.
3) Complete application pre-settings. Refer to "8 Applications - Getting Started".
4) **Select Accuracy Limit**:
   - **Status: On** to activate a warning message if the calculated standard deviation exceeds the limit.
   - Set the accuracy limits for the Easting, Northing and Height coordinates and the standard deviation angle.
   - Press **OK** to save the limits and return to the **Pre-settings** screen.
5) Select **GO!** to begin the application.

Enter target data
Enter the name of the station and the height of the instrument in the **Station data** screen and press **OK**.

Next step
To access the **Sight target point** screen:

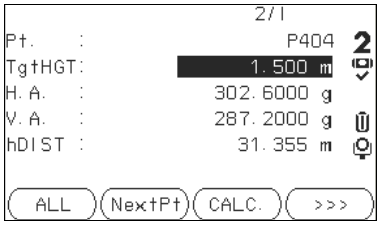
- Either, press **OK** after entering the target data fields in the **Target data** screen.
- Or, press >>> **SKIP** to skip entering the target data fields again when measuring the same point in another face.

Sight target point

In the **Sight target point** screen:

2 / I: Indicates that the second point was measured in face I.

2 / I II: Indicates that the second point was measured in faces I and II.



CALC.

To calculate and display the station coordinates, if at least two points and a distance were measured.

NextPt

To return to the **Enter target data** screen to select the next known point.

Next step

- Either, press **NextPt** to measure the next known point.
- Or, press **CALC.** to calculate the station position.

9.7.2 Measuring Information

Measurement sequences

The following measurement sequences are possible:

- Horizontal direction and vertical-angles only (resection)
- Distance and horizontal direction and vertical-angle
- Horizontal direction and vertical-angles to some point(s) and horizontal direction and vertical angles plus distance to other point(s).

Single face I, single face II, or dual face I and II measurements are always possible. No specific point sequence or specific face sequences are required.

Dual face measurements

When measuring the same target in both faces, the reflector height may not be changed when observing in the second face. Error checks are made for dual face measurements to ensure the same point is sighted with the other face.

☞

- If a target point is measured several times in the same face, only the last valid measurement is used for computation.
- For the calculation of the station position, measured target points can be re-measured, included in calculations, or excluded from calculations.

Measurements not included in computations
Target points with 0.000 height are discarded for height processing. If a target point has a valid height of 0.000 m, use 0.001 m to include it for height processing.

9.7.3 Computation Procedure

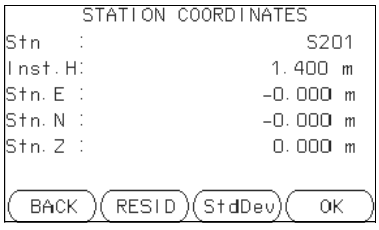
Description
The measuring procedure automatically determines the method of evaluation, for example resection or three point resection.
If more than the minimum required measurements are performed, the procedure uses a least squares adjustment to determine the 3D position and averages orientation and height measurements.

- The original averaged face I and face II measurements are used for the computation process.
- All measurements are treated with the same accuracy, whether these are measured in single or dual face.
- Easting and Northing are determined by the least squares method, which includes standard deviation and improvements for horizontal direction and horizontal distances.
- The final height (H) is computed from averaged height differences based on the original measurements.
- The horizontal direction is computed with the original averaged face I and face II measurements and the final computed plan position.

9.7.4 Resection Results

Access
Press **CALC.** from the **Sight target point** screen after at least two points and a distance have been measured.

STATION COORDINATES
This screen displays calculated station coordinates. The final computed results are Easting, Northing and Height coordinates of the present instrument station, including the instrument height.
Standard deviations and residuals for accuracy assessments are provided.



RESID
To display residuals. Refer to "Target Residuals".

StdDev
To display the standard deviation of the coordinates and angle.

☞ If the instrument height was set to 0.000 in the setup screen, then the station height refers to the height of the tilting axis.

Next step
Press **RESID** to display the target residuals.

Target Residuals
The **TARGET RESIDUALS** screen displays the computed residuals for the horizontal and vertical distances and the horizontal direction. Residual = Calculated value - Measured value.

Messages
The following are important messages or warnings that may appear.

Messages	Description
Selected point has no valid data!	This message occurs if the selected target point has no Easting or Northing coordinate.
Max 5 points supported!	5 points have already been measured and another point is selected. The system supports a maximum of 5 points.
Invalid data - no position computed!	The measurements may not allow final station coordinates (Eastings, Northings) to be computed.
Invalid data - no height computed!	Either the target height is invalid or insufficient measurements are available to compute a final station height.
HA (I - II) > 0.9 deg, measure point again!	This error occurs if a point was measured in one face and the measurement in the other face differs by more than 180° ± 0.9° for the horizontal angle.
VA (I - II) > 0.9 deg, measure point again!	This error occurs if a point was measured in one face and the measurement in the other face differs by more than 360° - VA ± 0.9° for the vertical angle.
More points or distance required!	There is insufficient data measured to be able to compute a position. Either there are not enough points used or not enough distances measured.

Next step
Press **OK** to return to the **APPS** menu.

9.8 Set Out

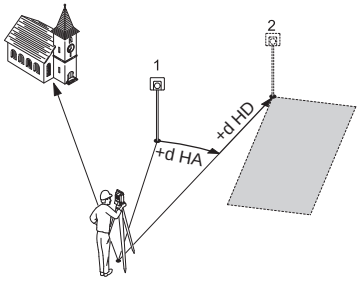
Description

Set Out is an application used to place marks in the field at predetermined points. These predetermined points are the points to be staked. The points to be staked may already exist in a job on the instrument, or be manually entered.
The application can continuously display differences, between current position and desired set out position.

Set Out modes

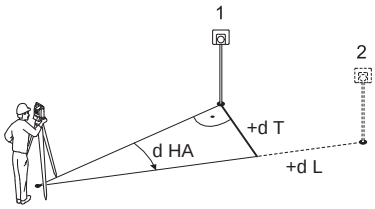
Points can be staked using different modes: Polar mode, Orthogonal to station mode and Cartesian mode.

Polar Set Out mode



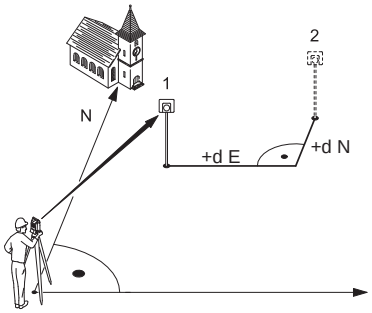
1 Current position
2 Point to be set out
dHDLongitudinal offset: positive if point to be setout is further away.
dHAAngle offset: positive if point to be setout is to the right of the actual direction.

Orthogonal to Station Set Out mode



1 Current position
2 Point to be set out
dL Longitudinal offset: positive if nominal point is further away.
dT Transversal offset, perpendicular to line-of-sight: positive if nominal point is to the right of the measured point.
dHAAngle offset: positive if nominal point is to the right of the actual direction.

Cartesian Set Out mode

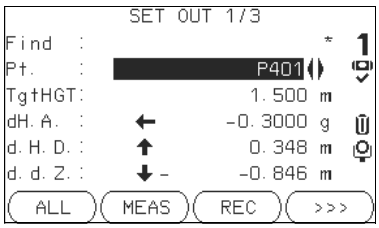


1 Current position
2 Point to be set out
d E Easting offset between point to be set out and actual point.
d N Northing offset between point to be set out and actual point.

Access

1) Select **Apps** from the **MAIN MENU**.
2) Select **Set Out** from the **APPS** menu.
3) Complete application pre-settings. Refer to "8 Applications - Getting Started".

SET OUT



>>> **MANUAL**
To manually enter coordinates of a point.

>>> **B&D**
To enter the direction and horizontal distance to a set out point.

Press to move through the pages. The bottom three measurement fields on the screen will change for the Polar, Orthogonal or Cartesian modes.

Field	Description
Find	Value for Point ID search. After entry, the firmware searches for matching points, and displays these in **Pt**: If a matching point doesn't exist the pointsearch screen opens.
d HA	Angle offset: Positive if set out point is to the right of the measured point.
d.H.D	Horizontal offset: Positive if set out point is further away than the measured point.
d.d.Z	Height offset: Positive if set out point is higher than the measured point.
dLength	Longitudinal offset: Positive if set out point is further away than the measured point.
dTrav.	Perpendicular offset: Positive if set out point is to the right of the measured point.
dE	Easting offset: Positive if set out point is to the right of the measured point.
dN	Northing offset: Positive if set out point is further away than the measured point
dZ	Height offset: Positive if set out point is higher than the measured point.

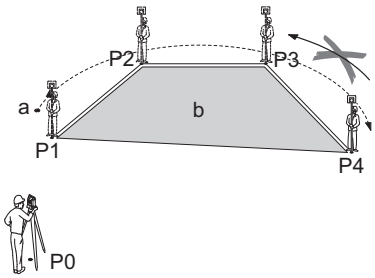
Next step

- Either, press **ALL** to record measurements for a set out point.
- Or, press **ESC** to exit the application.

9.9 Area & Volume

Description

Area is an application used to compute online areas to a maximum of 50 points connected by straights. The target points have to be measured, selected from memory, or entered via the keypad in a clockwise direction. The calculated area is projected onto the horizontal plane (2D) or projected onto the sloped reference plane defined by three points (3D). Furthermore a volume with constant height can be calculated in relation to the area (2D/3D).



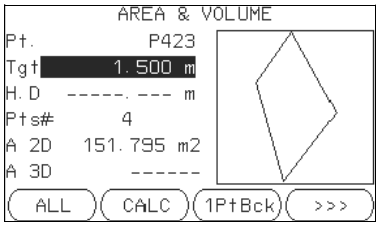
P0 Instrument station
P1 Start point
P2-4 Target points
a Perimeter, polygonal length from start point to the current measured point.
b Calculated area always closed to the start point P1, projected onto the horizontal plane.

Access

1) Select **Apps** from the **MAIN MENU**.
2) Select **Area & Volume** from the **APPS** menu.
3) Complete application pre-settings. Refer to "8 Applications - Getting Started".

AREA & VOLUME

The graphic always shows the area projected onto the horizontal plane.



1PtBACK
To undo measurement or selection of the previous point.

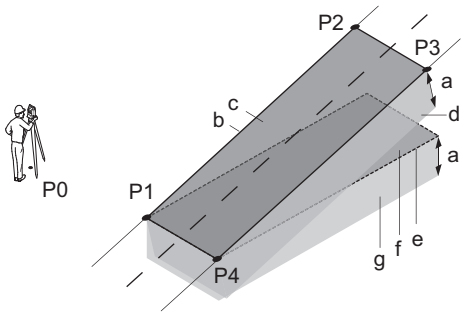
CALC
To display and record additional results (perimeter, volume).

>>> VOLUME
To calculate a volume with constant height. The heights have to be entered or measured.

>>> Def. 3D
To define the sloped reference plane by selecting or measuring three points.

The 2D area is calculated and displayed once three points have been measured or selected. The 3D area is calculated once the sloped reference plane is defined by three points.

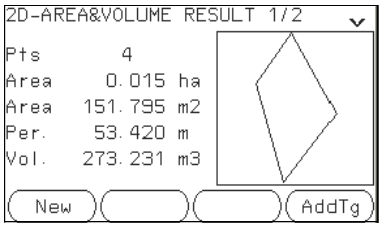
Graphical representation

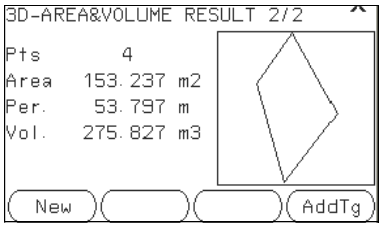


P0 Instrument station
P1 Target point which defines the sloped reference plane
P2 Target point which defines the sloped reference plane
P3 Target point which defines the sloped reference plane
P4 Target point
a Constant height
b Perimeter (3D), polygonal length from the start point to the current measured point of the area (3D)
c Area (3D), projected onto the sloped reference plane
d Volume (3D) = a x c
e Perimeter (2D), polygonal length from the start point to the current measured point of the area (2D)
f Area (2D), projected onto the horizontal plane
g Volume (2D) = f x a

Next step
Press **CALC** to calculate area and volume and proceed to the **Area & Volume Result** screens.

2D/3D-AREA & VOLUME RESULT





☞
Perimeter and volume are updated if further area points are added.

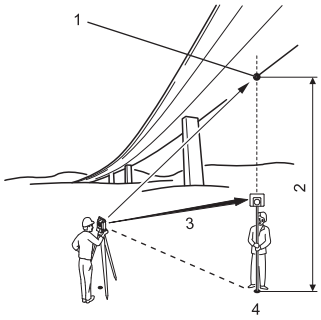
Next step

- Either, press **New** to define a new area.
- Or, press **AddTg** to add a new target point to the existing area.
- Or, press **ESC** to exit the application.

9.10 Remote Elevation

Description

Remote Elevation is an application used to compute points directly above the base prism without a prism at the target point.



1 Remote point
2 Height difference
3 Slope distance
4 Base point

Access

1) Select **Apps** from the **MAIN MENU**.
2) Select **Remote Elevation** from the **APPS** menu.
3) Complete application pre-settings. Refer to "8 Applications - Getting Started".

Remote elevation measurement

Measure to the base point or press >>> **Tgt.H=?** to determine an unknown reflector height.

Next step

After measuring, the **REMOTE ELEVATION** screen appears.

REMOTE ELEVATION - Aim at remote point

Aim the instrument at the inaccessible remote point.

Field	Description
hDIST	Height difference between the base point and the remote point.
Z	Height of the remote point.
d.d.Z	Calculated difference in Height between the base point and the remote point.

Next step

- Either, press **OK** to save the measurement of the remote point.
- Or, press **BACK** to enter and measure a new base point.
- Or, press **ESC** to exit the application.

9.11 Construction

9.11.1 Starting Construction

Description

Construction is an application used to define a construction site by combining set-up of the instrument along a construction line, measuring and setting out points in relation to the line.

Access

1) Select **Apps** from the **MAIN MENU**.
2) Select **Construction** from the **APPS** menu.
3) Select **Set EDM**: to set the EDM settings. Refer to "4.2 EDM Settings".
4) Select:
   - **New line** - To define a new construction site, or
   - **Continue with line** - To continue with a previous construction site (skips set-up).

☞ If coordinates were entered by **COORD** and measured to known points, a plausibility check displays the calculated line length, the actual length and the difference.

Next step

Measure to the line start and end points and the **LAY-OUT** screen appears.

9.11.2 Layout

Description

Search or enter points for setting out relative to the defined construction line. The on-screen graphics show the position of the prism relative to the set out point. Below the graphic, the exact values are displayed, combined with arrows to show the direction for setting out the point.

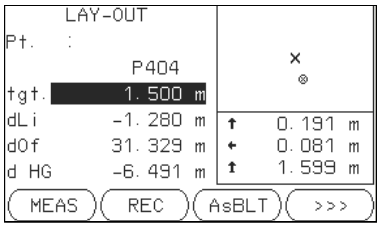
☞
- Be aware that the line start point and the line end point are measured in the previous coordinate system. When setting out these points they appear in the old system and appear as shifted.
- During use of the application the previous orientation and station parameters will be replaced by the new calculated ones. The line start point will be set to E=0, N=0.
- The height of the line start point is always used as the reference height!

Access

- Either, select **New line** from the Construction pre-settings screen and measure start and end points of the line.
- Or, select **Continue with line** from the Construction pre-settings screen.

LAY-OUT

The graphics are scaled to give a better overview. Therefore it is possible that the set out point moves in the graphic.



AsBLT
To switch to AsBuilt mode to check points relative to the construction line.

>>> Shift
To enter values for shifting the line.

Field	Description
dLi	Longitudinal offset: Positive if target point is further away than the measured point.
dOf	Perpendicular offset: Positive if target point is to the right of the measured point.
d HG	Height offset: Positive if target point is higher than the measured point.

Next step

- Either, press **AsBLT** to check point locations relative to a contruction line.
- Or, press **>>> Shift** to enter offset values for shifting the construction line.

9.11.3 As Built Check

Description

The As built screen displays the Line, Offset and d.d.Z of a measured point in relation to the construction line. The on-screen graphics show the position of the measured point relative to the construction line.

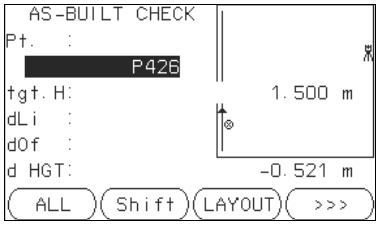
☞ The height of the line start point is always used as the reference height!

Access

Press **AsBLT** from the **LAY OUT** screen.

AS-BUILT CHECK

The graphics are scaled to give a better overview. Therefore it is possible that the station point moves in the graphics.



LAYOUT
To switch to Layout mode to set out points.

Shift
To enter values for shifting the line.

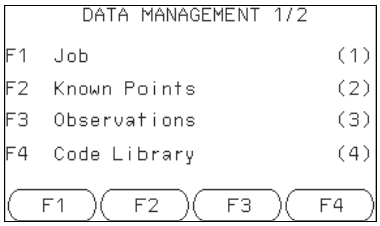
Field	Description
dLi	Longitudinal offset: Positive if measured point is further along the construction line from the start point.
dOf	Perpendicular offset: Positive if measured point is to the right of the construction line.
d HGT	Calculated difference in height: Positive if measured point is higher than the construction line start point height.

10 Data Management

10.1 Data Management

Access
Select **Data** from the **MAIN MENU**.

DATA MANAGEMENT
The Data Management menu contains all functions for entering, editing, checking and deleting data in the field.



F1-F4
To select menu item.

Menu item	Description
Job	To view, create and delete jobs. Jobs are a summary of data of different types, for example, known points, observations or codes. The job definition consists of the job name and user. The system generates time and date at the time of creation.
Known points	To view, create, edit and delete known points. Valid fixed points contain at least the point ID and the coordinates E, N or H.
Observations	To view and delete observation data. Observation data available in the internal memory can be searched for via a specific point search, or by viewing all points within a job.
Code Library	To view, create, edit and delete codes. To each code a description and a maximum of 8 attributes with up to 16 characters each can be assigned.
Formats	To view and delete data format files.
Erase Job Memory	To delete individual jobs, known points and measurements of a specific job or all jobs in the memory. ☞ Deleting the memory cannot be undone. After confirming the message all data is permanently deleted.
Memory Info	Displays job specific memory information such as the number of stored stations and known points within a job, the number of recorded data blocks, for example measured points, or codes within a job, and the memory space occupied.

Menu item	Description
USB-Explorer	To view, delete, rename and create folders and files stored on the USB memory stick. Only available for R6 instruments. Refer to "10.4 Working with a USB Memory Stick"and "Appendix B Directory Structure".

Next step

- Either, select a menu option using **F1** - **F4**.
- Or, press **ESC** to return to the **MAIN MENU**.

10.2 Exporting Data

Description

Job data can be exported from the internal memory of the instrument. Data can be exported via:

The RS232 serial interface

A receiver, such as a laptop, is connected to the RS232 port. The receiver requires R5/R6 or another third party software.

☞ If the receiver is too slow in processing data the data could be lost. With this type of data transfer the instrument is not informed about the performance of the receiver (no protocol). Therefore the success of this type of transfer is not checked.

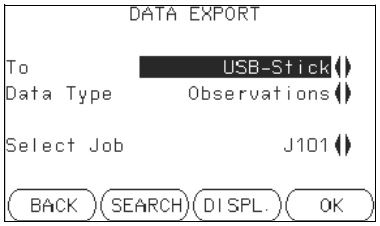
A USB memory stick

For R6 instruments. A USB memory stick can be inserted and removed from the USB host port. No additional software is required for the transfer.

Access

1) Select **Transfer** from the **MAIN MENU**.
2) Select **Export Data**.

DATA EXPORT



SEARCH
To search for jobs within the internal memory.

DISPL.
To list all jobs within the internal memory.

Field	Description
To	USB memory stick or RS232 serial interface.
Data Type	Data type to be transferred. **Observations**, **Known Points** or **Obs. & Known points**.
Select Job	Displays the selected job file.

Export data step-by-step

1) Press **OK** in the **DATA EXPORT** screen after selecting the export details.
2) Select the data format and press **OK** or **SEND**.

The **ASCII** data format is only available for data exports to a USB memory stick, not via the RS232 serial interface.

All jobs will be stored in the backup folder created on the USB memory stick. The job data will be stored as individual database files for each job, which can then be imported again. Refer to "10.3 Importing Data".

Exportable job data formats

Job data can be exported from a job in a variety of file types. A format can be defined in Stonex Software Format Manager. Refer to the online help of Stonex Software for information on creating format files.

RS232 example job data output

Within the **Data Type** setting **Observations**, a data set could be shown as follows:

11....+00000D19	21..022+16641826	22..022+09635023
31..00+00006649	58..16+00000344	81..00+00003342
82..00-00005736	83..00+00000091	87..10+00001700

GSI-IDs			GSI-IDs continued		
11	≙	Pt	41-49	≙	Codes and attributes
21	≙	Horizontal direction	51	≙	ppm [mm]
22	≙	Vertical angle	58	≙	Prism constants
25	≙	Orientation	81-83	≙	(E, N, H) Target point
31	≙	Slope distance	84-86	≙	(E, N, H) Station point
32	≙	Horizontal distance	87	≙	Reflector height
33	≙	Height difference	88	≙	Instrument height

10.3 Importing Data

Description

For R6 instruments, data can be imported to the internal memory of the instrument via a USB memory stick.

Importable data formats

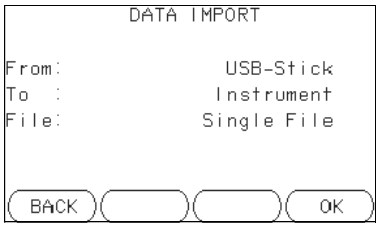
When importing data, the instrument automatically stores the file in a directory folder based on the file extension. The following data formats can be imported:

Data Type	File extension	Recognised as
GSI	.gsi	Known points
Format	.frt	Format file
Codelist	.cls	Codelist file

Access

1) Select **Transfer** from the **MAIN MENU**.
2) Select **Import Data**.

DATA IMPORT



Field	Description
From	**USB-Stick**
To	**Instrument**
File	**Single File**

Import data step-by-step

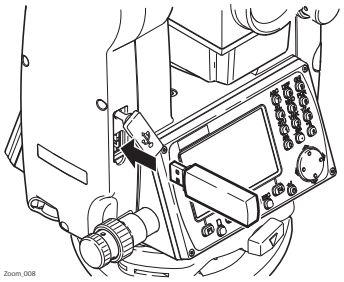
1) Press **OK** in the **DATA IMPORT** screen to proceed to the USB memory stick file directory.
2) Select the file on the USB memory stick to be imported and press **OK**.
3) Define the Job name for the imported file, and, if requested, the file definition and layers, and press **OK** to import. If a Job with the same name already exists in the internal memory,

a message will appear with the options to overwrite the existing job or rename the job for the file being imported.

4) A message will display once the file has been successfully imported.

10.4 Working with a USB Memory Stick

Insert a USB memory stick step-by-step



Lift the lid covering the USB host port on the R6 instrument.

Insert the USB memory stick into the USB host port.

☞ Always return to the **Main Menu** before removing the USB memory stick.

☞ Stonex® cannot be held responsible for data loss or any other error that may occur when using a USB memory stick.

☞
- Keep the USB memory stick dry.
- Use it only within the specified temperature range.
- Protect the USB memory stick from direct impacts.

Failure to follow these instructions could result in data loss and/or permanent damage to the USB memory stick.

10.5 Working with Bluetooth

Description

R6 instruments can communicate with external devices via a Bluetooth connection. The instrument Bluetooth is a slave only. The Bluetooth of the external device will be the master, and therefore will control the connection and any data transfer.

Establishing a connection step-by-step

1) On the instrument ensure that the communication parameters are set to **Bluetooth** and **On**. Refer to "4.3 Communication Settings".
2) Activate Bluetooth on the external device. The steps required depend on the Bluetooth driver and other device specific configurations. Refer to the device user manual for information on how to configure and search for a Bluetooth connection.

   The instrument will appear on the external device.

3 Some devices ask for the identification number of the Bluetooth. The default number for a R6 Bluetooth is 0000. This can be changed by:
   - Select **Settings** from the **MAIN MENU**.
   - Select **Comm**. from the **SETTINGS** menu.
   - Press **BTCode** from the **COMMUNICATION SETTINGS** screen.
   - Enter a new Bluetooth code in **BT-Code:**
   - Press **OK** to confirm the new Bluetooth code.

4 When the external Bluetooth device has located the instrument for the first time, a message will display on the instrument stating the name of the external device and requesting confirmation that connection to this device should be allowed.
   - Press **YES** to allow, or
   - Press **NO** to disallow this connection

5 The instrument Bluetooth sends out the instrument name and serial number to the external Bluetooth device.
6 All further steps must be made in accordance to the user manual of the external device.

Transferring data via Bluetooth

Using Stonex Software Data Exchange Manager, data files can be transferred from the instrument to a local folder via the Bluetooth connection. The transfer is made through the serial port configured on the computer as the Bluetooth Serial Port, however, for faster data transfer speeds we recommend using the USB or RS232 connections.
For more information about Stonex Software Data Exchange Manager refer to the comprehensive online help.
For transferring data using other external devices or software programs, refer to the user manual of the device or software. The R6 Bluetooth does not establish or manage the data transfer.

10.6 Working with Stonex Software and Stonex Software Tools

Description

The program package Stonex Software is used for the data exchange between the instrument and a computer. It contains several auxiliary programs in order to support the instrument.

Installation on a computer

The installation program can be found on the CD-ROM supplied. Insert the CD and follow the on-screen instructions. Please note that Stonex Software can only be installed on computers with MS Windows 2000, XP and Vista operating systems.

For more information about Stonex Software refer to the comprehensive online help.

11 Calibration

11.1 Overview

Description

Stonex® instruments are manufactured, assembled and adjusted to a high quality. Quick temperature changes, shock or stress can cause deviations and decrease the instrument accuracy. It is therefore recommended to calibrate the instrument from time to time. This can be done in the field by running through specific measurement procedures. The procedures are guided and have to be followed carefully and precisely as described in the following chapters. Some other instrument errors and mechanical parts can be adjusted mechanically.

Electronic calibration

The following instrument errors can be checked and calibrated electronically:

- Horizontal collimation error, also called line-of-sight error.
- Vertical index error, and simultaneously the electronic level.

☞
For determining these errors, it is necessary to measure in both faces, but the procedure can be started in any face.

Mechanical calibration

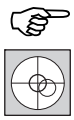
The following instrument parts can be calibrated mechanically:

- Circular level on the instrument and tribrach.
- Laser plummet.
- Screws on the tripod.

☞
During the manufacturing process, the instrument errors are carefully determined and set to zero. As mentioned, these errors can change and it is highly recommended to redetermine them in the following situations:

- Before the instrument is used for the first time.
- Before every high precision survey.
- After rough or long periods of transport.
- After long periods of work or storage.
- If the temperature difference between current environment and the temperature at the last calibration is more than 10°C (18°F).

11.2 Preparation



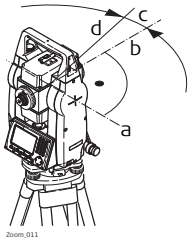
Before determining the instrument errors, level-up the instrument using the electronic level. The **Level & Plummet** is the first screen to appear after turning on the instrument.
The tribrach, the tripod and the ground should be very stable and secure from vibrations or other disturbances.

The instrument should be protected from direct sunlight in order to avoid thermal expansion on one side only.

Before starting to work, the instrument has to become acclimatised to the ambient temperature. Approximately two minutes per °C of temperature difference from storage to working environment, but at least 15 min, should be taken into account.

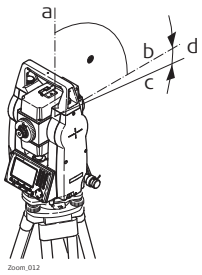
11.3 Calibrating Line-of-Sight and Vertical Index Error

Line-of-sight error
The line-of-sight error, or horizontal collimation error is the deviation from the perpendicular between the tilting axis and the line of sight. The effect of the line-of-sight error to the horizontal direction increases with the vertical angle.



a) Tilting axis
b) Line perpendicular to tilting axis
c) Horizontal collimation, or line-of-sight, error
d) Line-of-sight

Vertical index error
The vertical circle should read exactly 90° (100 gon) when the line of sight is horizontal. Any deviation from this figure is termed vertical index error. This is a constant error that affects all vertical angle readings.



a) Mechanical vertical axis of the instrument, also called standing axis
b) Axis perpendicular to the vertical axis. True 90°
c) Vertical angle is reading 90°
d) Vertical index error

By determining the vertical index error the electronic level is adjusted automatically

Access

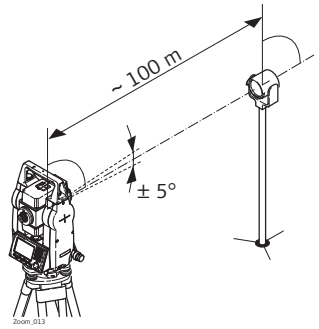
1) Select **Tools** from the **MAIN MENU**.
2) Select **Calibr.** from the **TOOLS MENU**.

- Select:
  - **HA-collimation**, or
  - **Vertical Index**.

☞ The procedures and conditions required to correct line-of-sight and vertical index errors are the same, therefore the procedure will only be described once.

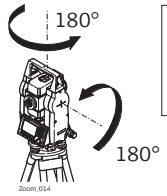
Calibration step-by-step

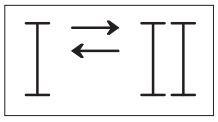
1) Level the instrument with the electronic level. Refer to "3 Operation"- "Level up with the electronic level step-by-step".

2 

Aim at a point approximately 100 m from the instrument which is within 5° of the horizontal.

3 Press **REC** to measure to the target point.

4 


Change face and aim at the target point again

☞ For checking the horizontal aim, the difference in HA and VA are displayed.

5 Press **REC** to measure to the target point.

☞ The old and new calculated values are displayed.

6 Either:

- Press **OK** to save the new calibration data, or
- Press **ESC** to exit without saving the new calibration data.

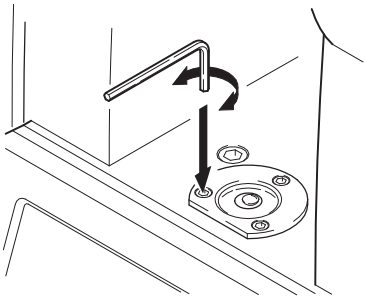
Messages

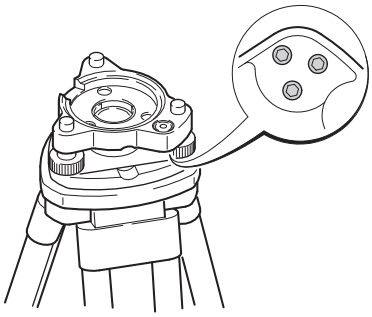
The following are important messages or warnings that may appear.

Messages	Description
VA-angle not suitable for adjustment !	The vertical angle deviates from the required horizontal / line-of-sight, or in face II the vertical angle deviates by more than 5° from the target point. Aim at the target point with an accuracy of min. 5°. Confirmation of the message required.
Results out of tolerance. Previous values retained !	Computed values out of tolerance. The previous values are retained and measurements should be repeated. Confirmation of the message required.
HA-angle not suitable for adjustment !	Horizontal angle in face II deviates by more than 5° from the target point. Aim on the target point with an accuracy of min. 5°. Confirmation of the message required.
Measurement Error. Try again.	Measurement error appears when, for example, there is an unstable set up. Repeat the process. Confirmation of the message required.
Time limit exceeded ! Please repeat adjustment !	Time difference between measurements for results storage exceeds 15 minutes. Repeat the process. Confirmation of the message required.

11.4 Calibrating the Circular Level of the Instrument and Tribrach

Calibrate the circular level step-by-step





1 Place and secure the tribrach onto the tripod, and then secure the instrument onto the tribrach.
2 Using the tribrach footscrews, level the instrument with the electronic level. To activate the electronic level, turn on the instrument, and, if tilt correction is set to 1- or 2-axis, the **Level & Plummet** screen appears automatically. Alternatively, press **FNC** from within any application and select **Level & Plummet**.
3 The bubbles of the instrument and tribrach levels must be centered. If one or both circular levels are not centered, adjust as follows.

Instrument: If the bubble extends beyond the circle, use the Allen key supplied to center it with the adjustment screws.
Tribrach: If the bubble extends beyond the circle, adjust it using the adjustment pin in conjunction with the adjustment screws. Turn the adjustment screws:

- To the left: and the bubble approaches the screw.
- To the right: and the bubble goes away from the screw.

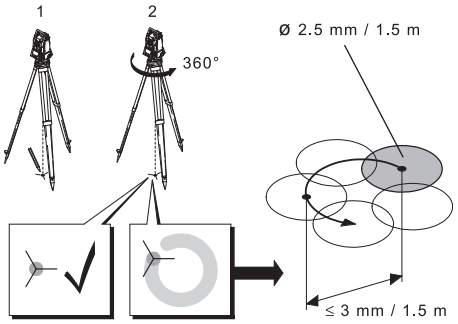
4 Repeat step 3 on the instrument and tribrach until both circular levels are centered and no further adjustments are necessary.

☞ After the calibration, no adjustment screw should be loose.

11.5 Inspecting the Laser Plummet of the Instrument

☞ The laser plummet is integrated into the vertical axis of the instrument. Under normal conditions of use, the laser plummet does not need adjusting. If an adjustment is necessary due to external influences, the instrument has to be returned to a Stonex® service department.

Inspect the laser plummet step-by-step



1) Set up the instrument on the tripod approximately 1.5 m above the ground and level up.
2) To activate the laser plummet, turn on the instrument, and, if tilt correction is set to 1- or 2-axis, the laser plummet will be activated automatically, and the **Level & Plummet** screen appears. Otherwise, press **FNC** from within any application and select **Level & Plummet**.

   ☞ Inspection of the laser plummet should be carried out on a bright, smooth and horizontal surface, such as a sheet of paper.

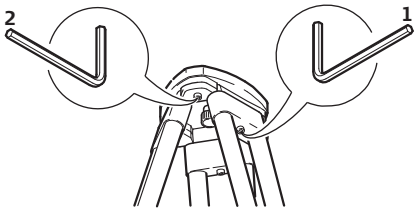
3 Mark the center of the red laser dot on the ground.
4 Turn the instrument slowly through 360°, carefully observing the movement of the red laser dot.

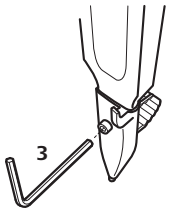
   ☞ The maximum diameter of the circular movement described by the center of the laser dot should not exceed 3 mm at a height of 1.5 m.

5 If the center of the laser dot makes a clearly circular movement, or moves more than 3 mm away from the point which was first marked, an adjustment may be required. Call your nearest Stonex® service department.
   Depending on brightness and surface type, the size of the laser dot can vary. At a height of 1.5 m an average diameter of 2.5 mm is estimated.

11.6 Servicing the Tripod

Service the tripod step-by-step





☞ The connections between metal and timber components must always be firm and tight.

1) Tighten the leg cap screws moderately with the allen key supplied.
2) Tighten the articulated joints on the tripod head just enough to keep the tripod legs open when lifting the tripod off the ground.
3) Tighten the screws of the tripod legs.

12 Care and Transport

12.1 Transport

Transport in the field

When transporting the equipment in the field, always make sure that you

- either carry the product in its original transport container,
- or carry the tripod with its legs splayed across your shoulder, keeping the attached product upright.

Transport in a road vehicle

Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container and secure it.

Shipping

When transporting the product by rail, air or sea, always use the complete original Stonex® packaging, transport container and cardboard box, or its equivalent, to protect against shock and vibration.

Shipping, transport of batteries

When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping, contact your local passenger or freight transport company.

Field adjustment

After transport inspect the field adjustment parameters given in this user manual before using the product.

12.2 Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "14 Technical Data" for information about temperature limits.

Field adjustment

After long periods of storage inspect the field adjustment parameters given in this user manual before using the product.

Li-Ion batteries

- Refer to "14 Technical Data" for information about storage temperature range.
- At the recommended storage temperature range, batteries containing a 10% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged.
- Remove batteries from the product and the charger before storing.
- After storage recharge batteries before using.
- Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use.
- A storage temperature range of -20°C to +30°C/-4°F to 86°F in a dry environment is recommended to minimise self-discharging of the battery.

12.3 Cleaning and Drying

Objective, eyepiece and reflectors

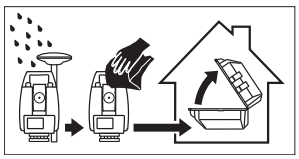
- Blow dust off lenses and prisms.
- Never touch the glass with your fingers.
- Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol. Do not use other liquids; these may attack the polymer components.

Fogging of prisms

Prisms that are cooler than the ambient temperature tend to fog. It is not enough simply to wipe them. Keep them for some time inside your jacket or in the vehicle to allow them to adjust to the ambient temperature.

Damp products

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40°C /104°F and clean them. Do not repack until everything is completely dry. Always close the transport container when using in the field.



Cables and plugs

Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.

13 Safety Directions

13.1 General

Description
The following directions enable the person responsible for the product, and the person who actually uses the equipment, to anticipate and avoid operational hazards.

The person responsible for the product must ensure that all users understand these directions and adhere to them.

13.2 Intended Use

Permitted use
- Measuring horizontal and vertical angles.
- Measuring distances.
- Recording measurements.
- Visualizing the aiming direction and vertical axis.
- Data communication with external appliances.
- Computing by means of software.

Adverse use
- Use of the product without instruction.
- Use outside of the intended limits.
- Disabling safety systems.
- Removal of hazard notices.
- Opening the product using tools, for example screwdriver, unless this is specifically permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.
- Use of products with obviously recognisable damages or defects.
- Use with accessories from other manufacturers without the prior explicit approval of Stonex®.
- Aiming directly into the sun.
- Inadequate safeguards at the working site, for example when measuring on roads.
- Deliberate dazzling of third parties.
- Controlling of machines, moving objects or similar monitoring application without additional control- and safety installations.

Warning
Adverse use can lead to injury, malfunction and damage.

It is the task of the person responsible for the equipment to inform the user about hazards and how to counteract them. The product is not to be operated until the user has been instructed on how to work with it.

13.3 Limits of Use

Environment
Suitable for use in an atmosphere appropriate for permanent human habitation: not suitable for use in aggressive or explosive environments.

Danger
Local safety authorities and safety experts must be contacted before working in hazardous areas, or close to electrical installations or similar situations by the person in charge of the product.

13.4 Responsibilities

Manufacturer of the product

Stonex® Europe srl, IT-20052 Monza, hereinafter referred to as Stonex®, is responsible for supplying the product, including the user manual and original accessories, in a safe condition.

Manufacturers of non Stonex® accessories

The manufacturers of non Stonex® accessories for the product are responsible for developing, implementing and communicating safety concepts for their products, and are also responsible for the effectiveness of those safety concepts in combination with the Stonex® product.

Person in charge of the product
The person in charge of the product has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual.
- To be familiar with local regulations relating to safety and accident prevention.
- To inform Stonex® immediately if the product and the application becomes unsafe.
- To ensure that the national laws, regulations and conditions for the operation of radio transmitters are respected.

Warning
The person responsible for the product must ensure that it is used in accordance with the instructions. This person is also accountable for the training and the deployment of personnel who use the product and for the safety of the equipment in use.

13.5 Hazards of Use

Warning

The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or adverse use, and can cause accidents with far-reaching human, material, financial and environmental consequences.

Precautions:

All users must follow the safety directions given by the manufacturer and the directions of the person responsible for the product.

Caution

Watch out for erroneous measurement results if the product has been dropped or has been misused, modified, stored for long periods or transported.

Precautions:

Periodically carry out test measurements and perform the field adjustments indicated in the user manual, particularly after the product has been subjected to abnormal use and before and after important measurements.

Danger

Because of the risk of electrocution, it is dangerous to use poles and extensions in the vicinity of electrical installations such as power cables or electrical railways.

Precautions:

Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their instructions.

Caution

Be careful when pointing the product towards the sun, because the telescope functions as a magnifying glass and can injure your eyes and/or cause damage inside the product.

Precautions:

Do not point the product directly at the sun.

Warning

During dynamic applications, for example stakeout procedures there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around, for example obstacles, excavations or traffic.

Precautions:

The person responsible for the product must make all users fully aware of the existing dangers.

Warning

Inadequate securing of the working site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations.

Precautions:

Always ensure that the working site is adequately secured. Adhere to the regulations governing safety and accident prevention and road traffic.

Warning

If computers intended for use indoors are used in the field there is a danger of electric shock.

Precautions:

Adhere to the instructions given by the computer manufacturer regarding field use with Stonex® products.

Caution

If the accessories used with the product are not properly secured and the product is subjected to mechanical shock, for example blows or falling, the product may be damaged or people can sustain injury.

Precautions:

When setting-up the product, make sure that the accessories are correctly adapted, fitted, secured, and locked in position.
Avoid subjecting the product to mechanical stress.

Warning

If the product is used with accessories, for example masts, staffs, poles, you may increase the risk of being struck by lightning.

Precautions:

Do not use the product in a thunderstorm.

Warning

If charged or discharged, batteries not recommended by Stonex® may be damaged. They may burn and explode.

Precautions:

Only charge and discharge batteries recommended by Stonex®.

Warning

Using a battery charger not recommended by Stonex® can destroy the batteries. This can cause fire or explosions.

Precautions:

Only use chargers recommended by Stonex® to charge the batteries.

Caution

During the transport, shipping or disposal of batteries it is possible for inappropriate mechanical influences to constitute a fire hazard.

Precautions:

Before shipping the product or disposing of it, discharge the batteries by running the product until they are flat.

When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping contact your local passenger or freight transport company.

Warning

High mechanical stress, high ambient temperatures or immersion into fluids can cause leakage, fire or explosions of the batteries.

Precautions:

Protect the batteries from mechanical influences and high ambient temperatures. Do not drop or immerse batteries into fluids.

Warning

If battery terminals come in contact with jewellery, keys, metallised paper or other metals, short circuited battery terminals can overheat and cause injury or fire, for example by storing or transporting in pockets.

Precautions:

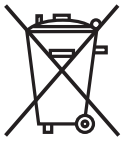
Make sure that the battery terminals do not come into contact with metallic objects.

Warning

If the product is improperly disposed of, the following can happen:

- If polymer parts are burnt, poisonous gases are produced which may impair health.
- If batteries are damaged or are heated strongly, they can explode and cause poisoning, burning, corrosion or environmental contamination.
- By disposing of the product irresponsibly you may enable unauthorised persons to use it in contravention of the regulations, exposing themselves and third parties to the risk of severe injury and rendering the environment liable to contamination.

Precautions:



The product must not be disposed with household waste.
Dispose of the product appropriately in accordance with the national regulations in force in your country.
Always prevent access to the product by unauthorised personnel.

Warning

Only Stonex® authorised service workshops are entitled to repair these products.

13.6 Laser Classification

13.6.1 General

General

The following directions (in accordance with the state of the art - international standard IEC 60825-1 (2007-03) and IEC TR 60825-14 (2004-02)) provide instruction and training information to the person responsible for the product and the person who actually uses the equipment, to anticipate and avoid operational hazards.

The person responsible for the product must ensure that all users understand these directions and adhere to them.

☞ Products classified as laser class 1, class 2 and class 3R do not require:

- laser safety officer involvement,
- protective clothes and eyewear,
- special warning signs in the laser working area

if used and operated as defined in this user manual due to the low eye hazard level.

☞ Products classified as laser class 2 or class 3R may cause dazzle, flash-blindness and afterimages, particularly under low ambient light conditions.

13.6.2 Distancer, Measurements with Reflectors

General

The EDM module built into this product produces a visible laser beam which emerges from the telescope objective.

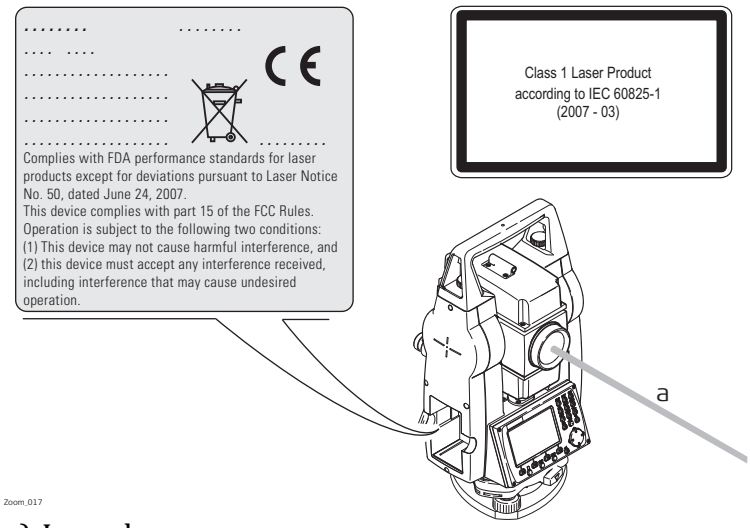
The laser product described in this section, is classified as laser class 1 in accordance with:

- IEC 60825-1 (2007-03): "Safety of laser products".
- EN 60825-1 (2007-10): "Safety of laser products".

Class 1 laser products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with this user manual.

Description	Value
Maximum average radiant power	0.33 mW
Pulse duration	800 ps
Pulse repetition frequency	100 MHz - 150 MHz
Wavelength	650 nm - 690 nm

Labelling


Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
Class 1 Laser Product
according to IEC 60825-1
(2007 - 03)
a
Zoom_017

a) Laser beam

13.6.3 Distancer, Measurements without Reflectors (Reflectorless mode)

General

The EDM module built into the product produces a visible laser beam which emerges from the telescope objective.

The laser product described in this section is classified as laser class 3R in accordance with:
- IEC 60825-1 (2007-03): "Safety of laser products".
- EN 60825-1 (2007-10): "Safety of laser products".

Class 3R laser products:
Direct intrabeam viewing may be hazardous (low-level eye hazard), in particular for deliberate ocular exposure. The risk of injury for laser class 3R products is limited because of:
- unintentional exposure would rarely reflect worst case conditions of (e.g.) beam alignment with the pupil, worst case accommodation,
- inherent safety margin in the maximum permissible exposure to laser radiation (MPE), natural aversion behaviour for exposure to bright light for the case of visible radiation.

Description	Value (A2/A4/A6)
Maximum average radiant power	5.00 mW
Pulse duration	800 ps
Pulse repetition frequency	100 MHz - 150 MHz
Wavelength	650 nm - 690 nm
Beam divergence	0.2 mrad x 0.3 mrad
NOHD (Nominal Ocular Hazard Distance) @ 0.25 s	80 m / 262 ft

Warning

From a safety perspective class 3R laser products should be treated as potentially hazardous.

Precautions:

Prevent direct eye exposure to the beam. Do not direct the beam at other people.

Warning

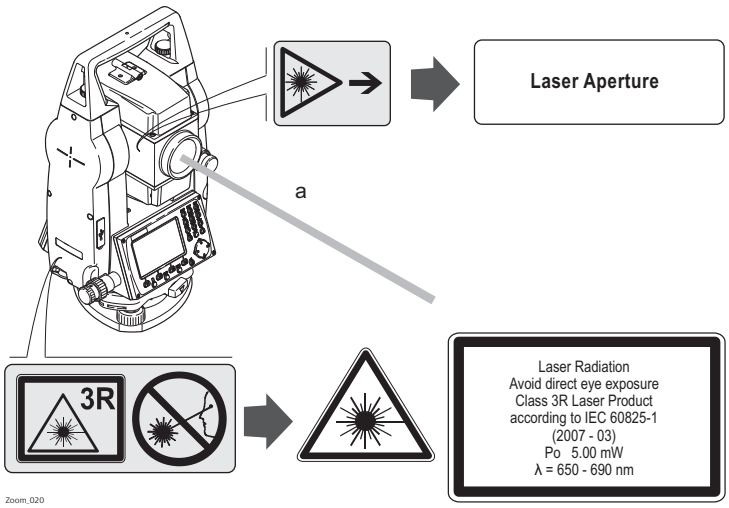
Potential hazards are not only related to direct beams but also to reflected beams aimed at reflecting surfaces such as prisms, windows, mirrors, metallic surfaces etc.

Precautions:

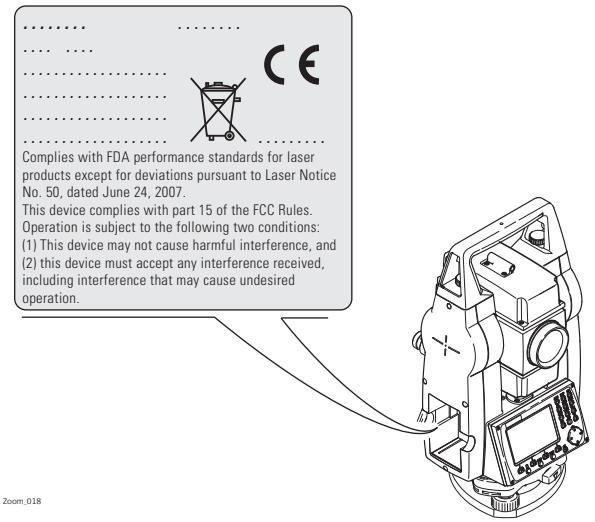
Do not aim at areas that are essentially reflective, such as a mirror, or which could emit unwanted reflections.

Do not look through or beside the optical sight at prisms or reflecting objects when the laser is switched on, in laser pointer or distance measurement mode. Aiming at prisms is only permitted when looking through the telescope.

Labelling



a) Laser beam


Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
Zoom_018

13.6.4 Laser Plummet

General

The laser plummet built into the product produces a visible red laser beam which emerges from the bottom of the product.

The laser product described in this section, is classified as laser class 2 in accordance with:

- IEC 60825-1 (2007-03): "Safety of laser products".
- EN 60825-1 (2007-10): "Safety of laser products".

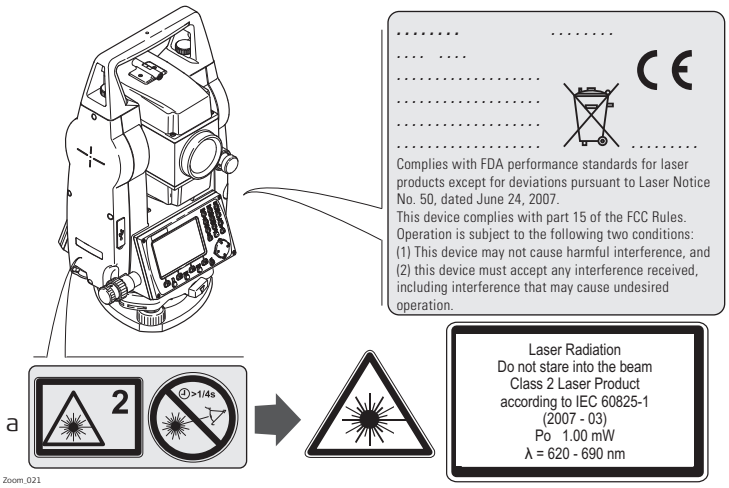
Class 2 laser products:
These products are safe for momentary exposures but can be hazardous for deliberate staring into the beam.

Description	Value
Maximum average radiant power	0.95 mW
Pulse duration	c.w.
Pulse repetition frequency	c.w.
Wavelength	635 nm

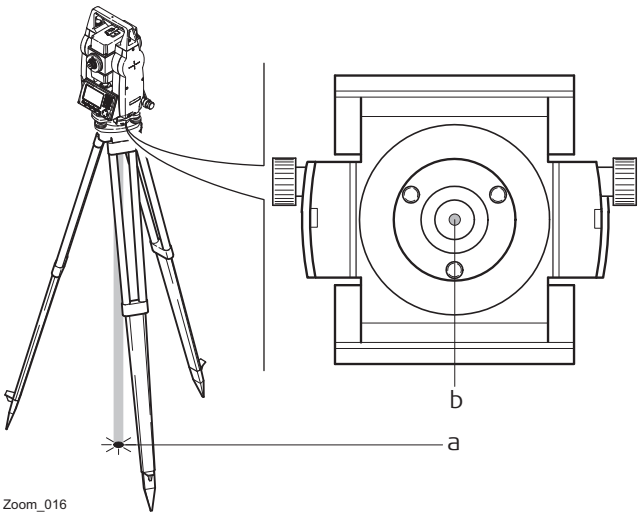
Warning

From a safety perspective class 2 laser products are not inherently safe for the eyes.
Precautions:
Avoid staring into the beam or pointing the beam at other people.

Labelling


Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
a
2
>1/4s
Laser Radiation
Do not stare into the beam
Class 2 Laser Product
according to IEC 60825-1
(2007 - 03)
Po 1.00 mW
λ = 620 - 690 nm
Zoom_021

a) Will be replaced by a Class 3R warning label if applicable



a) Laser beam
b) Exit for laser beam

13.7 Electromagnetic Compatibility EMC

Description
The term Electromagnetic Compatibility is taken to mean the capability of the product to function smoothly in an environment where electromagnetic radiation and electrostatic discharges are present, and without causing electromagnetic disturbances to other equipment.

Warning
Electromagnetic radiation can cause disturbances in other equipment.

Although the product meets the strict regulations and standards which are in force in this respect, Stonex® cannot completely exclude the possibility that other equipment may be disturbed.

Caution
There is a risk that disturbances may be caused in other equipment if the product is used with accessories from other manufacturers, for example field computers, personal computers, two-way radios, non-standard cables or external batteries.
Precautions:
Use only the equipment and accessories recommended by Stonex®. When combined with the product, they meet the strict requirements stipulated by the guidelines and standards. When using computers and two-way radios, pay attention to the information about electromagnetic compatibility provided by the manufacturer.

Caution
Disturbances caused by electromagnetic radiation can result in erroneous measurements. Although the product meets the strict regulations and standards which are in force in this respect, Stonex® cannot completely exclude the possibility that the product may be disturbed by intense electromagnetic radiation, for example, near radio transmitters, two-way radios or diesel generators.
Precautions:
Check the plausibility of results obtained under these conditions.

Warning
If the product is operated with connecting cables attached at only one of their two ends, for example external supply cables, interface cables, the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other products may be impaired.
Precautions:
While the product is in use, connecting cables, for example product to external battery, product to computer, must be connected at both ends.

Bluetooth
Use of product with Bluetooth:

Warning

Electromagnetic radiation can cause disturbances in other equipment, in installations, in medical devices, for example pacemakers or hearing aids and in aircraft. It can also affect humans and animals.

Precautions:

Although the product meets in combination with radio or digital cellular phone devices recommended by Stonex® the strict regulations and standards which are in force in this respect, Stonex® cannot completely exclude the possibility that other equipment may be disturbed or that humans or animals may be affected.

- Do not operate the product with radio or digital cellular phone devices in the vicinity of filling stations or chemical installations, or in other areas where an explosion hazard exists.
- Do not operate the product with radio or digital cellular phone devices near to medical equipment.
- Do not operate the product with radio or digital cellular phone devices in aircraft.

13.8 FCC Statement, Applicable in U.S.

Applicability

The greyed paragraph below is only applicable for R5 instruments.

Warning

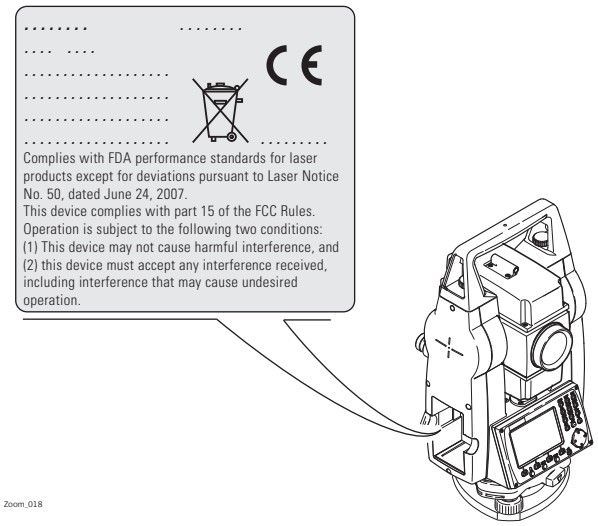
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

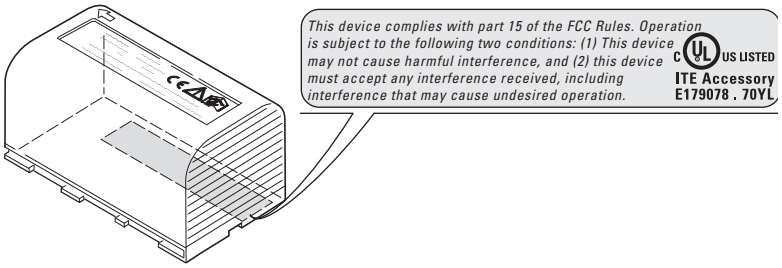
Warning

Changes or modifications not expressly approved by Stonex® for compliance could void the user's authority to operate the equipment.

Labelling R5/R6 instrument


Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
Zoom_018

Labelling internal battery SB21


This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
c UL us LISTED
ITE Accessory
E179078 . 70YL

14 Technical Data

14.1 Angle Measurement

Accuracy

Available angular accuracies	Standard deviation HA, VA, ISO 17123-3	Display resolution			
["]	[mgon]	["]	[°]	[mgon]	[mil]
2	0.6	1	0.0001	0.1	0.01
5	1.5	1	0.0001	0.1	0.01

Characteristics

Absolute, continuous, diametric. Updates each 0.1 to 0.3 s.

14.2 Distance Measurement with Reflectors

Range

Reflector	Range A		Range B		Range C	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard prism	1800	6000	3000	10000	3500	12000
3 prisms	2300	7500	4500	14700	5400	17700
Reflector foil 60 mm x 60 mm	150	500	250	800	250	800

Shortest measuring distance: 1.5 m

Atmospheric conditions

Range A: Strong haze, visibility 5 km; or strong sunlight, severe heat shimmer
Range B: Light haze, visibility about 20 km; or moderate sunlight, slight heat shimmer
Range C: Overcast, no haze, visibility about 40 km; no heat shimmer

Accuracy

Accuracy refers to measurements to standard reflectors.

EDM measuring mode	Standard deviation ISO 17123-4	Measurement time, typical [s]
IR-Default	2 mm + 2 ppm	2.4
IR-Quick	5 mm + 2 ppm	0.8
IR-Continuous	5 mm + 2 ppm	<0.15
Foil	5 mm + 2 ppm	2.4

Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.

Characteristics

Principle: Phase measurement
Type: Coaxial, visible red laser
Carrier wave: 658 nm
Measuring system: System analyser basis 100 MHz - 150 MHz

14.3 Distancer, Measurements without Reflectors (Reflectorless mode)

Range

A2 (without reflector)

Kodak Gray Card	Range D		Range E		Range F	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
White side, 90 % reflective	150	490	180	590	≤250	≤820
Grey side, 18 % reflective	80	260	100	330	≤110	≤360

A4 (without reflector)

Kodak Gray Card	Range D		Range E		Range F	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
White side, 90 % reflective	200	660	300	990	>400	>1310
Grey side, 18 % reflective	100	330	150	490	>200	>660

A6 (without reflector)

Kodak Gray Card	Range D		Range E		Range F	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
White side, 90 % reflective	350	1150	450	1480	≤600	≤1970
Grey side, 18 % reflective	200	660	250	820	≤350	≤1150

Range of Measurement: 1.5 m to 1200 m
Display unambiguous: up to 1200 m

Atmospheric conditions

Range D: Object in strong sunlight, severe heat shimmer
Range E: Object in share, or overcast
Range F: Day, night and twilight

Accuracy

Standard measuring	ISO 17123-4	Measure time, typical [s]	Measure time, maximum [s]
0 m - 500 m	3 mm + 2 ppm	3 - 6	12
>500 m	4 mm + 2 ppm	3 - 6	12

Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.

Continuous measuring*	Standard deviation	Measure time, typical [s]
Continuous	5 mm + 3 ppm	0.25

* Accuracy and measure time depend on atmospheric conditions, target object and observation situation.

Characteristics

Type: Coaxial, visible red laser
Carrier wave: 658 nm
Measuring system: System analyser basis 100 MHz - 150 MHz

Laser dot size

Distance [m]	Laser dot size, approximately [mm]
at 30	7 x 10
at 50	8 x 20

14.4 Distance Measurement Reflector (Long Range)

Range

A2, A4, A6, (with reflector)	Range A		Range B		Range C	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard prism	2200	7300	7500	24600	>10000	>33000
Reflector foil 60 mm x 60 mm	600	2000	1000	3300	1300	4200

Range of measurement: From 1000 m up to 12000 m
Display unambiguous: Up to 12 km

Atmospheric conditions

Range A: Strong haze, visibility 5 km; or strong sunlight, severe heat shimmer
Range B: Light haze, visibility about 20 km; or moderate sunlight, slight heat shimmer
Range C: Overcast, no haze, visibility about 40 km; no heat shimmer

Accuracy

Standard measuring	ISO 17123-4	Measure time, typical [s]	Measure time, maximum [s]
Long range	5 mm + 2 ppm	2.5	12

Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.

Characteristics

Principle: Phase measurement
Type: Coaxial, visible red laser
Carrier wave: 658 nm
Measuring system: System analyser basis 100 MHz - 150 MHz

14.5 Conformity to National Regulations

14.5.1 R5

Conformity to national regulations

CE

Hereby, Stonex® Europe srl, declares that the instrument is in compliance with the essential requirements and other relevant provisions of applicable European Directives. The declaration of conformity is available from Stonex®.

14.5.2 R6

Conformity to national regulations

- FCC Part 15 (applicable in US).
- Hereby, Stonex® Europe srl, declares that the R6 instrument is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity is available from Stonex® Europe srl.

CE Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA Member state.

- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

Frequency band
2402 - 2480 MHz

Output power

Bluetooth: 2.5 mW

14.6 General Technical Data of the Instrument

Telescope

Magnification:	30 x
Free Objective aperture:	40 mm
Focusing:	1.7 m/5.6 ft to infinity
Field of view:	1°30'/1.66 gon. 2.7 m at 100 m

Compensation
Quadruple axis compensation (2-axis compensator with HA-collimation and VA-Index).

Angular accuracy	Setting accuracy		Setting range	
["]	["]	[mgon]	[']	[gon]
2	0.5	0.2	±4	0.07
5	1.5	0.5	±4	0.07

Level

Circular level sensitivity: 6’/2 mm
Electronic level resolution: 2"

Control unit

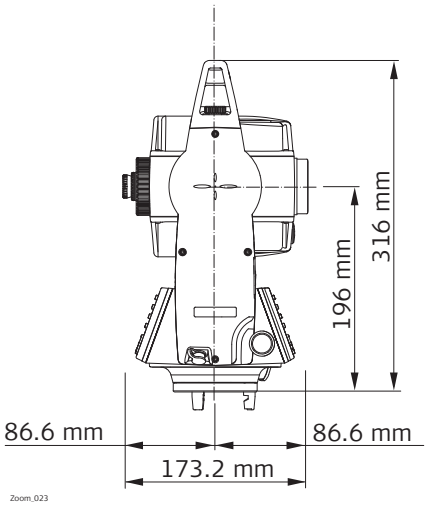
Display: 280 x 160 pixels, LCD, backlit, 8 lines with 31 characters each, heatable (temp. <-5°).

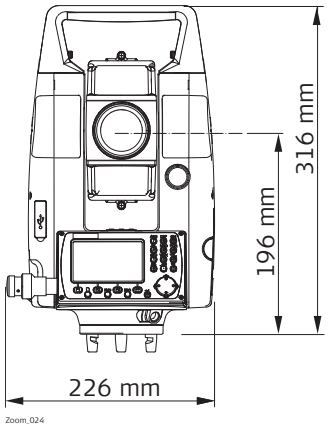
Instrument Ports

Name	Description
RS232	6 pin Hiroshi for power, communication, data transfer. This port is located at the base of the instrument.
USB host port*	USB memory stick port for data transfer.
Bluetooth*	Bluetooth connections for communication and data transfer.

* Only for R6 instruments.

Instrument Dimensions





Weight

Instrument: 4.2 kg - 4.5 kg (depending on hardware configuration)
Tribrach: 760 g
Battery SB21: 110 g

Tilting axis height

Without tribrach:	196 mm
With tribrach:	240 mm ±5 mm

Recording

Model	Memory Type	Number of measurements
R5 / R6	Internal memory	10,000

Laser plummet

Type:	Visible red laser class 2
Location:	In standing axis of instrument
Accuracy:	Deviation from plumb line: 1.5 mm (2 sigma) at 1.5 m instrument height
Diameter of laser point:	2.5 mm at 1.5 m instrument height

Power

External supply voltage: (via serial interface)	Nominal voltage 12.8 V DC, Range 11.5 V-14 V

Battery SB21

Type:	Li-Ion
Voltage:	7.4 V
Capacity:	2.2 Ah
Operating time*:	approximately 9 hours

* Based on a single measurement every 30 s at 25°C. Operating time may be shorter if battery is not new.

Environmental specifications

Temperature

Type	Operating temperature		Storage temperature	
	[°C]	[°F]	[°C]	[°F]
R5/R6 instrument	-20 to +50	-4 to +122	-40 to +70	-40 to +158
Battery	-20 to +50	-4 to +122	-40 to +70	-40 to +158
USB memory stick	-40 to +85	-40 to +185	-50 to +95	-58 to +203

Protection against water, dust and sand

Type	Protection
R5/R6 instrument	IP54 (IEC 60529)

Humidity

Type	Protection
R5/R6 instrument	Max 95% non condensing. The effects of condensation are to be effectively counteracted by periodically drying out the instrument.

Automatic corrections

The following automatic corrections are made:

- Line of sight error
- Tilting axis error
- Earth curvature
- Standing axis tilt
- Vertical index error
- Refraction
- Compensator index error
- Circle eccentricity

14.7 Scale Correction

Use of scale correction

By entering a scale correction, reductions proportional to distance can be taken into account.

- Atmospheric correction.
- Reduction to mean sea level.
- Projection distortion.

Atmospheric correction

The distance displayed is correct if the scale correction in ppm, mm/km, which has been entered corresponds to the atmospheric conditions prevailing at the time of the measurement.

The atmospheric correction includes:

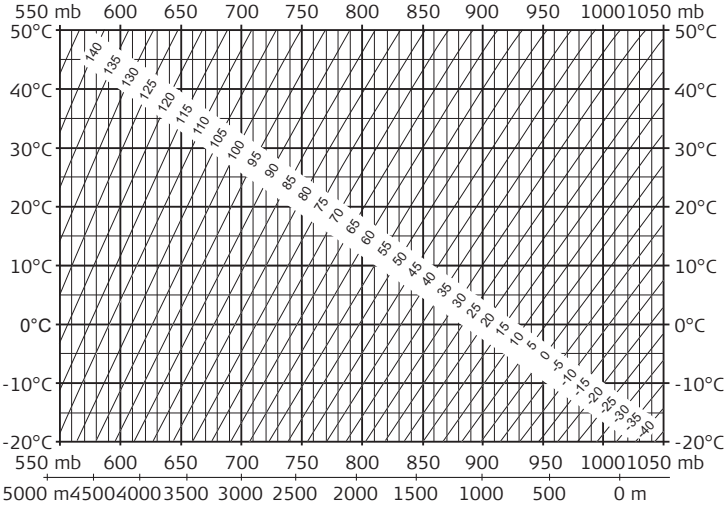
- Adjustments for air pressure
- Air temperature

For highest precision distance measurements, the atmospheric correction should be determined with:

- An accuracy of 1 ppm
- Air temperature to 1°C
- Air pressure to 3 mbar

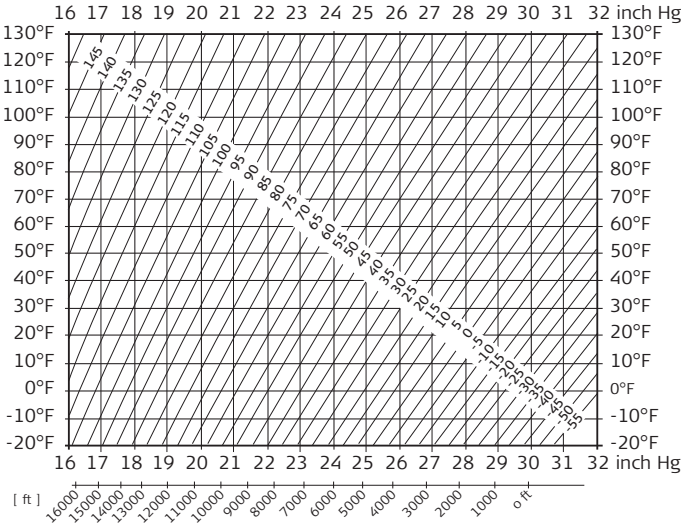
Atmospheric corrections °C

Atmospheric corrections in ppm with temperature [°C], air pressure [mb] and height [m] at 60 % relative humidity.



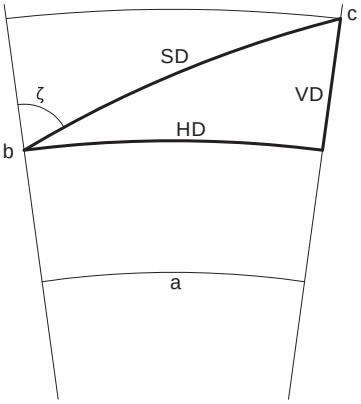
Atmospheric correction °F

Atmospheric corrections in ppm with temperature [°F], air pressure [inch Hg] and height [ft] at 60 % relative humidity.



14.8 Reduction Formulas

Formulas



a Mean Sea Level
b Instrument
c Reflector
SD Slope distance
HD Horizontal distance
VD Height difference

The instrument calculates the slope distance, horizontal distance, and height difference in accordance with the following formulas. Earth curvature (1/R) and mean refraction coefficient (k = 0.13) are automatically taken into account when calculating the horizontal distance and height difference. The calculated horizontal distance relates to the station height and not to the reflector height.

Slope distance

$$SD = D_0 \cdot (1 + ppm \cdot 10^{-6}) + mm$$

SD Displayed slope distance [m]
D0 Uncorrected distance [m]
ppmAtmospheric scale correction [mm/km]
mmprism constant [mm]

Horizontal distance

$$HD = Y - A \cdot X \cdot Y$$

HD Horizontal distance [m]
Y SD * sinζ
X SD * cosζ
ζ = Vertical circle reading
A $(1 - k/2)/R = 1.47 * 10^{-7}$ [m^{-1}]
k = 0.13 (mean refraction coefficient)
R = $6.378 * 10^6$ m (radius of the earth)

Height difference

$$VD = X + B \cdot Y^2$$

VD Height difference [m]
Y SD * sinζ
X SD * cosζ
ζ = Vertical circle reading
B $(1 - k)/2R = 6.83 * 10^{-8}$ [m^{-1}]
k = 0.13 (mean refraction coefficient)
R = $6.378 * 10^6$ m (radius of the earth)

15 Standard Limited Warranty

One (1) year on Stonex® products

The terms and conditions of this Limited Warranty constitute the complete and exclusive warranty agreement between the customer and Stonex® for the product and supersede any prior agreement or representation made in any Stonex® sales document or advice that may be provided to customer by any Stonex® representative in connection with customer's purchase of the product. No change to the conditions of this Limited Warranty is valid unless it is made in written form and signed by an authorised Stonex® supervisor.

Stonex® Europe warrants that its products:

1) are free from defects in materials or workmanship;
2) are in conformity with the factory specifications in effect at the time they were manufactured; have been tested/calibrated in proper working status prior to shipment.

At its sole discretion, Stonex® Europe will restore the product to original working order (in accordance with factory specifications in effect at the time the product was manufactured) OR replace the product with one at least equivalent to the original product. Replaced parts or products are warranted to be free from defects in materials and workmanship for thirty (30) days OR for the remainder of the Limited Warranty Period of the product in which they are installed, whichever is longer. Parts or products replaced under this Limited Warranty shall become property of Stonex® Europe. All parts that have to be replaced have to be returned to our representative office location via any delivery company the customer prefers, nevertheless Stonex® Europe is not accountable for the unlikely event that the products gets lost in transit.

For accessories provided by Stonex with the Total Stations R5/R6 the warranty time is 90 days, including all power supply accessories and batteries.

Warranty repair(s) policy

Customer shall pay the standard repair fees for any service (whether part replacement or repairs) excluded from this Limited Warranty and performed by Stonex® Europe under request and explicit authorisation of the customer itself. In this case the customer is charged for return shipment's fees as well. ANY DAMAGE INFLICTED BY THE CUSTOMER OR BY THIRDPARTY AFTER THE PRODUCTS HAS BEEN DELIVERED TO THE CUSTOMER IS EXCLUDED FROM THE LIMITED WARRANTY AS WELL ANY DAMAGE ARISING FROM AN IMPROPER USE, FROM ANY ACTION OR USE NOT PROVIDED FOR IN THE ENCLOSED USER GUIDES AND/OR MANUALS.

Shipping policy

Once warranty is over and/or for reasons stated above, the Customer or the dealer from whom the customer has bought the product (whichever is agreed upon) in required to pay for the charges for shipping to Stonex® Europe representative office (address listed above) and Stonex® Europe will provide the shipping for return. Any other purported transfer or assignment of this Limited Warranty is void.

Return policy

All returned products have to be shipped to Stonex® Europe representative office. The original Purchaser has a period of seven (7) days or otherwise specified to return any purchase for a full refund (less shipping and handling), provided the merchandise is in new,resalable condition and returned in the original, undamaged packaging. Customer has to pay
for both the return and the original freight fees, regardless of the original freight paid by the Company. All warranty books, instruction manuals, parts and accessories must be included as well the original box in which the item was shipped. We recommend to place the original carton inside another box, to avoid any additional damage to the carton itself. In some cases, returns of special items will require a re-stock fee, as imposed by the manufacturer. Used items may not be returned, if in anyway damaged. Acceptance of returned merchandise is final only after inspection by Stonex® Europe.

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CUSTOMER SPECIFIC LEGAL RIGHTS, AND CUSTOMER MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM COUNTRY/STATE/JURISDICTION TO COUNTRY/STATE/JURISDICTION.

Environmental recycling

The cardboard box, the plastic in the package and the various parts of this product have to be recycled and disposed of in accordance with the current legislation of your Country.

FOR COUNTRIES IN THE EUROPEAN UNION (EU)

a) The disposal of electric and electronic device as solid urban waste is strictly prohibited: they must be collected separately.

b) Contact Local Authorities to obtain practical information about correct handling of the waste, location and times of waste collection centres. When you buy a new device of ours, you can give back to our dealer a used similar device.

c) The dumping of these devices at unequipped or unauthorised places may have hazardous effects on health and environment.

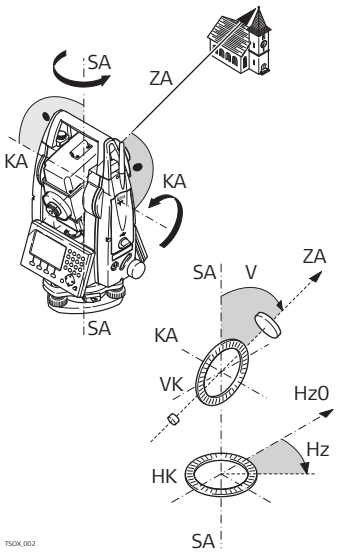
d) The crossed dustbin symbol means that the device must be taken to authorised collection centres and must be handled separately from solid urban waste.

FOR COUNTRIES OUTSIDE EUROPEAN UNION (EU)

The treatment, recycling, collection and disposal of electric and electronic devices may vary in accordance with the laws in force in the Country in question.

16 Glossary

Instrument axis



ZA **= Line of sight / collimation axis**
Telescope axis = line from the cross hairs to the center of the objective.

SA **= Standing axis**
Vertical rotation axis of the telescope.

KA **= Tilting axis**
Horizontal rotation axis of the telescope. Also known as the Trunion axis.

V **= Vertical angle / zenith angle**

VK **= Vertical circle**
With coded circular division for reading the vertical angle.

Hz **= Horizontal direction**

HK **= Horizontal circle**
With coded circular division for reading the horizontal angle.

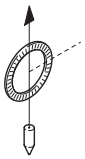
Plumb line / compensator

Direction of gravity. The compensator defines the plumb line within the instrument.

Standing axis inclination

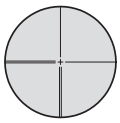
Angle between plumb line and standing axis.
Standing axis tilt is not an instrument error and is not eliminated by measuring in both faces. Any possible influence it may have on the horizontal direction or vertical angle is eliminated by the dual axis compensator.

Zenith



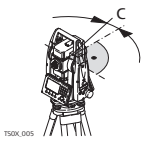
Point on the plumb line above the observer.

Crosshairs



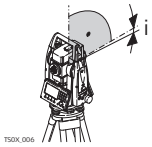
Glass plate within the telescope with reticle.

Line-of-sight error (horizontal collimation)



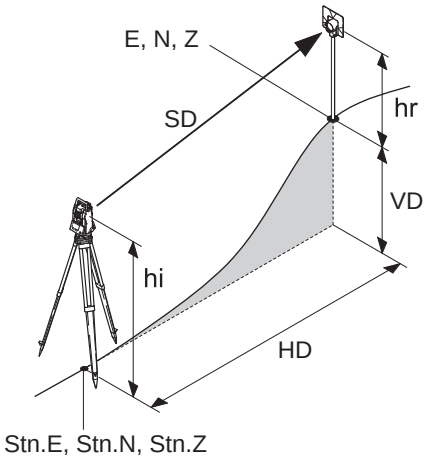
The line-of-sight error (c) is the deviation from the perpendicular between the tilting axis and line of sight. This could be eliminated by measuring in both faces.

Vertical index error



With a horizontal line of sight the vertical circle reading should be exactly 90°(100 gon). The deviation from this value is termed the Vertical index error (i).

Explanation of displayed data



SD Indicated meteorological corrected slope distance between instrument tilting axis and center of prism/laser dot

HD Indicated meteorological corrected horizontal distance

VD Height difference between station and target point

hr Reflector height above ground

hi Instrument height above ground

Stn.E, Stn.N, Stn.Z
Easting, Northing and Height coordinates of station

E, N, Z
Easting, Northing and Height coordinates of target point

Appendix AMenu Tree

Depending on local firmware versions the menu items may differ.

Menu Tree

- **Apps**
  - Survey
  - Reference Element
  - COGO
  - Missing Line Measurement
  - Resection
  - Setout
  - Area & Volume
  - Remote Elevation
  - Construction
- **Data**
  - Jobs
  - Known Points
  - Observations
  - Code Library
  - Formats
  - Erase Job Memory
  - Memory Info
  - USB-Explorer
- **Settings**
  - General
    - Contrast, Tilt Correction, HA Correction, Face I Definition, HA Increment, VA-Setting, Angle Unit, Minimum Reading, Distance Unit, Temperature Unit, Pressure Unit, Beep, Sector Beep, Screen Illumination, Crosshair Illumination, Heating, Data Output, GSI Format, Mask, Code Saving, Language, Auto-Off.
  - EDM
    - EDM Setting, Atmospheric Data, Free Entry PPM, Projection Scale, EDM Signal Reflection, EDM Frequency
  - Comm.
    - Communication Settings, Bluetooth Code
- **Survey**
- **Transfer**
  - Export Data
  - Import Data

Tools

- Calibration
  - HA-Collimation
  - Vertical Index
- Auto start
- System Info
  - Instrument Information, Software Information, Set Date, SetTime
- Load Firmware
  - Firmware, Languages Only

Appendix BDirectory Structure

Description

On the USB memory stick, files are stored in certain directories. The following diagram is the default directory structure.

Directory Structure

|—— **CODES**	• Codelists (*.cls)
|	
|—— **FORMATS**	• Format files (*.frt)
|	
|—— **JOBS**	• GSI, DXF, ASCII files (*.*) • Logfiles created from applications
|	
|—— **SYSTEM**	• Firmware files • Language files • Configuration files (*.cfg)
|	
|	
|	

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